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HYPERPLASIA OF THE ENDOMETRIUM AND THE HORMONES OF THE ANTERIOR HYPOPHYSIS AND THE OVARIES[1]

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HYPERPLASIA of the endometrium is not only one of the most important factors in any consideration of abnormal uterine bleeding but presents an interesting endocrine problem, the solution of which should do much to further our understanding of the phenomena of menstruation. It should, therefore, not be considered as merely a local reaction in the uterine mucosa but as a clinicopathological entity, and from this aspect the recent advances in our knowledge of the sex hormones of the anterior hypophysis and the ovaries have served to clarify certain obscure features of the condition. The present study was undertaken in order to consider the relationship between the various hormones and hyperplasia endometrii, and to analyze the clinical and pathological findings in a series of 75 cases.

HISTORY

According to Olshausen and Bischoff, it would seem that the earliest clinical observations of this condition were made by members of the French school, as for instance Robert in 1846, Robin in 1848, and Nélaton in 1853. It was described as an overgrowth of endometrium forming sessile or polypoid masses, frequently containing dilated "utricular" glands, and was given the name of *état fongueux*. In 1850, Récamier advised the use of the curette as a method of treatment, but met with opposition when Aran (1858) and Becquerel (1859) decried such a "hazardous" and "barbarous" procedure. However, it is very likely that these pioneers included in this category other polypoid conditions of the endometrium as well as hyperplasia, and the first histological description was given in a notable paper by Olshausen in 1875, in which it is evident that he recognized its association with uterine bleeding and gave it the name of "endometritis fungosa" or "chronic hyperplastic endometritis." This was succeeded by the studies of Bischoff in 1878 and Ruge in 1880, and in 1882 Brennecke made his invaluable contribution. This author recognized certain characteristic changes in the ovaries of patients with endometritis fungosa, namely, a thickening of the tunica albuginea, the presence of unruptured follicles, and an absence of corpora lutea, and postulated the theory that these changes are directly responsible for the endometrial lesion (endometritis ovarialis). During the following 18 years, a number of investigators discussed this problem (Czempin; Gottschalk; Winternitz; Bulius and Kretschmar; Franz), and in 1900 Cullen (19) gave the first description in this country. In this book and in subsequent writings (20, 21) he established the close relationship between this lesion and uterine bleeding at the time of puberty

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and the menopause and its identity from malignancy, and gave it the name of "hyperplasia of the endometrium."

Although a number of later workers considered the relationship between ovarian pathology and endometrial lesions leading to abnormal uterine hæmorrhage (Kaji; Lauth; Poelzl; Adler, 1), it remained for R. Schroeder (73, 74) in 1915 and again in 1919 to present a complete analysis of the whole problem with an extensive series of cases, and to formulate his theory of the "persistent ripening follicle." This was followed in 1920 by a noteworthy contribution by R. Meyer (57) who, however, gave an interpretation of the ovarian changes different from that of Schroeder. Among the valuable studies on the anatomical changes of the endometrium in hyperplasia published between 1900 and 1920 were those of Buettner, Kjaegaard, Driessen, and Novak (62), while since that time the problem in regard to both endometrium and ovary has been extensively discussed by Novak (63), Seitz, Babes (7), Runge, Novak and Martzloff, Adler (2), Beckman, and Shaw. And finally, a new era has been ushered in with the development of hormonal studies and in regard to hyperplasia of the endometrium the names of Siebke, Frank, and Zondek must be regarded as pioneers in the field.

TERMINOLOGY

There is as yet no satisfactory all-embracing name which would establish the clinicopathological entity of this condition. The use of the term "endometritis" with adjectives such as "hyperplastic," "polypoid," "fungosa," "ovarialis," should be discouraged because of the implied relation to infection. "Glandular hyperplasia" and "glandular-cystic hyperplasia" describe only one phase of the endometrial picture, while "hyperplasia endometrii" is descriptive of only the uterine manifestation of the disease. The use of Schroeder's "metropathia hæmorrhagica" is of value but is liable to be confused with other conditions also resulting in uterine bleeding and hence must be mentioned with his name. Since the etiology of the disease is as yet obscure, it is probably better to refer to it by one of the terms describing the pathology of the endometrium, and defer the adoption of an inclusive name until later.

CLINICAL CHARACTERISTICS

This study is based on a series of 75 cases of hyperplasia endometrii from the gynecological service of the Stanford University School of Medicine and from private practice. They were taken consecutively and in every instance the diagnosis was established by a histological examination of the endometrium.

Incidence. Schroeder (76) has estimated that glandular hyperplasia occurred in approximately 0.8 to 1.0 per cent of all the patients attending the clinics of Rostock and Kiel. The figures from the Stanford Gynecological Service also point to the frequency and importance of this disease. In the last 1,700 hospital admissions it was demonstrated in 40 cases, an incidence of 2.8 per cent, while of 507 women with abnormal uterine hæmorrhage 62, or 12.2 per cent, were found to have a hyperplasia endometrii (Fluhmann and Morse).

Age of occurrence. Many authors have devoted considerable attention to the age incidence of hyperplasia, and the findings of this series are listed in Table I. It is seen that hyperplasia is a disease most frequently found at the time of the menopause since more than 50 per cent of all cases occurred in women over the age of 35. This was also shown in a previous study (Fluhmann, 31), where it was found that of 33 women over 40 years of age with so called "idiopathic uterine hæmorrhage" the presence of hyperplasia was demonstrated in the endometrium in 23 instances. It must be observed, however, that the condition may occur at any time after the menarche, and in the postclimacteric period it may

TABLE I.—AGE INCIDENCE IN GLANDULAR HYPERPLASIA ENDOMETRII

Age	No. of cases	Per cent
15–19	2	2.6
20–24	2	2.6
25–29	5	6.7
30–34	13	17.4
35–39	16	21.3
40–44	13	17.4
45–49	18	24.0
50–55	6	8.0
Total	75	

accompany certain ovarian new-growths. Although it has been cited as an important factor in "puberty bleeding" (Wolfe), in this series there were only two patients of less than 20 years of age.

Gravidarity. Of the 75 patients of this series, 53 had had full-term pregnancies preceding the onset of the present condition, 14 were nulligravidæ, while 8 had had from 1 to 5 abortions and had not carried a baby to term. It was also noted that 29 of the multigravidæ had had previous abortions. It is questionable if this feature was a direct result of the hyperplasia. A more likely explanation is that these patients had hæmorrhages following a period of amenorrhœa, which is a characteristic feature of hyperplasia, and thus led to a faulty diagnosis. In 2 cases the patients had full term pregnancies subsequent to a curettage which demonstrated a hyperplasia endometrii.

Symptoms. The outstanding symptom of hyperplasia endometrii is that of abnormal uterine bleeding, a fact which led Schroeder to apply the term "metropathia hæmorrhagica" to this condition. It was found that the patients of this series could be classed into two main categories according to certain characteristics of the bleeding, and in accordance with previous studies (Fluhmann 28, 31; Fluhmann and Morse) each of these was again divided into a number of subgroups.

In the first large group were 25 patients in whom there was a definite cycle in the appearance of periods of bleeding and intervals of rest. These again were subdivided into:

1. A group of 12 patients (16.0 per cent) who complained of *menorrhagia*, that is, who had a 28 or 30 day cycle but the period of bleeding had become very profuse or prolonged as compared to the preceding menses.

2. Thirteen patients (17.4 per cent) stated that they had "irregular menses" in that (a) periods of blood loss occurred at less than 4 week intervals (8 cases), or (b) at intervals of longer than 4 weeks (3 cases), or (c) were very irregular, the interval sometimes being shorter and sometimes longer than 4 weeks (2 cases).

In the remaining two-thirds of the cases, the bleeding was prolonged, continuous, or intermittent, in duration. These again were divided into smaller groups:

1. A period of continuous bleeding which persisted until the patient was admitted for treatment and which set in following previously normal menses, was found in 12 instances (16.0 per cent). In 10 cases the onset of the hæmorrhage coincided with the time a menstrual period was due and in 2 cases it occurred a short time after the completion of a normal period.

2. A small group of 5 cases (6.7 per cent) was characterized by a progressive condition initiated by profuse or irregular periods of blood loss which became gradually worse until eventually they ended in atypical or irregular bleeding.

3. In 14 cases (18.6 per cent) continuous bleeding set in following a period of amenorrhœa. This feature is of considerable importance from a diagnostic standpoint and may be considered as a very characteristic symptom of hyperplasia endometrii. The period of amenorrhœa is usually of from 6 to 8 weeks in duration, but in this series it lasted for 2 months or longer in 6 cases, and in 2 instances was as long as 7 months and 2 years respectively.

4. In 18 patients (24.0 per cent) the type of bleeding was absolutely atypical and irregular as to time, intensity, and duration.

5. One patient with hyperplasia endometrii accompanying an ovarian new-growth had irregular bleeding although she had passed the menopause 2 years previously.

Duration of symptoms. The length of time symptoms were present before the patients came for treatment has proved to be a very variable factor and depended a great deal on the type and severity of the bleeding, for instance the patients with "menorrhagia" usually reporting later. The duration varied between 2 weeks and 7 years. Sixteen patients had had bleeding for less than 3 months, 14 for from 3 to 6 months, 13 for from 6 months to 1 year, 12 for from 1 to 2 years, and 13 for more than 2 years, while in 7 instances this information had not been obtained.

Associated conditions. (a) Systemic disease. Although a few of the patients suffered from complications such as cardiovascular disease, nephritis, etc., no connection between these and hyperplasia endometrii could be estab-

Fig. 1.

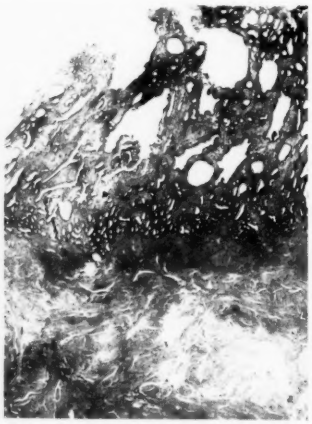

Fig. 2.

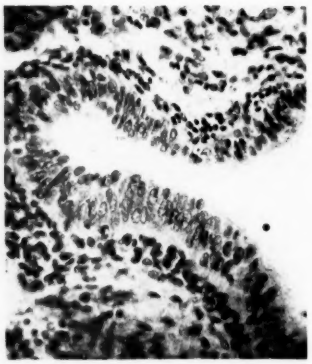

Fig. 3.

Fig. 1. Photomicrograph illustrating various types of irregular glands in hyperplasia endometrii. (Spec. No. A975-1.) x 75.

Fig. 2. Cystic glands and a dense stroma are characteristic features of hyperplasia endometrii. (Spec. No. 9358-6.) x 6.

Fig. 3. Stratification of the glandular cylindrical epithelium. (Spec. No. A4137.) x 335.

lished. The information available also failed to point to any definite relationship with known endocrine disturbances and led one to believe that no such connection existed. Only 4 patients had had a basal metabolic rate done, and since the results showed 1 as plus 17, another as minus 19, and the other 2 as plus 4 and plus 3 respectively it was impossible to demonstrate any characteristic involvement of the thyroid gland. In a number of instances a marked secondary anæmia was present, a direct result of the severe hæmorrhages associated with hyperplasia endometrii.

(b) Pelvic disease. On the other hand, pelvic conditions associated with hyperplasia endometrii were found in approximately 30 per cent of the cases. In 8 instances fibromyomata were present, in 2 fibromyomata and endometrial polypi, in 1 an adenomyoma, in 1 a polyp of the cervix uteri, in 3 endometrial polypi, in 8 a retroversio uteri, and in 1 an early prolapsus uteri. In view of the relationship between the ovary and the endometrium in this disease, it was interesting to find a granulosa-cell carcinoma in one case, a small fibroma in 3 cases, and a very small serous cystadenoma in one instance.

Pelvic examination. Although in most cases no gross pathology can be made out on pelvic examination and as a result patients with hyperplasia endometrii not complicated by other pelvic disease belong to the indefinite category of "idiopathic uterine hæmorrhage," there are generally a few very suggestive findings for the careful observer. These are most readily demonstrated if the patient is actually bleeding at the time the examination is made and simulate the picture of an early abortion. There is a congestion of the pelvic organs, turgor and slight enlargement of the uterus, and a softening at the level of the internal os similar to the well known Hegar's sign. In a considerable number of instances, it is also possible to palpate the ovaries and to find that one or both are somewhat enlarged and cystic.

PATHOLOGY OF THE ENDOMETRIUM

The pathological material available for this study was composed of a single specimen of curettings in 50 cases, of 2 specimens of curettings obtained at different times in 1 case, of both curettings and the uterus (removed at a later period) in 8 cases, and of the uterus alone in 16 instances. The tissues were fixed in formalin, mounted in paraffin, and the sections were stained routinely with eosin and hæmatoxylin. In certain cases special stains, such as van Gieson's for collagen fibrils, mucicar-

min for secretory changes in the glands, and methyl-green pyronin for plasma cells, were employed.

The gross appearance of the endometrium shows that in many instances it is markedly thickened and œdematous and large amounts of material may be obtained as the result of a curettage. In some cases the surface is rugged and shows irregular prominences, a feature which led to the use of the terms "polypoid" and "fungous." Although the occurrence of definite polypi is supposedly a frequent accompaniment it was noted in only 5 of the 75 cases of this series.

The diagnosis is established, however, by a microscopic examination of the endometrium, and in order to recognize the significance of certain histological changes, it is necessary to remember that differences occur depending on whether the specimen is obtained at a time when the patient is bleeding or not. This is a fundamental principle regarding any studies on the endometrium, for we are dealing with a structure which is never in a state of "rest" but undergoes daily variations during the active sexual life of the individual, and although hyperplasia is considered as a pathological condition there is nevertheless a process of growth, destruction, and repair bearing a similarity to the events of the normal menstrual cycle.

A. *Hyperplasia endometrii in non-bleeding cases.* The endometrium presents an appearance which at once suggests an intense growth activity. It has essentially the same features throughout its whole depth, and it may be difficult even to differentiate the basal from the functional layer. The normal cyclical changes are not present. The stroma is dense and cellular, the cells are spindle-shaped, and evidence of active proliferation is seen in numerous mitotic figures. Special staining methods reveal the presence of collagen fibrils (Schroeder, 76; Babes, 7), and œdema is frequently present. In many cases there are also important vascular changes. During the stage of proliferation in the normal endometrium, one usually sees larger branches of blood vessels near the basalis, whereas only an occasional one is visible in the superficial layers. In hyperplasia the presence of numerous large

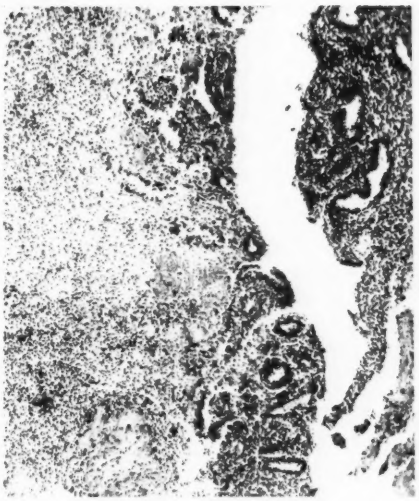

Fig. 4. Areas of tissue disintegration, the local factor responsible for uterine hæmorrhage. (Spec. No. A2801.) x 75.

vessels extending throughout the whole depth of the tissue is a prominent feature, and in some instances there are markedly dilated veins under the surface epithelium.

It is in the glands, however, that one must look for the most striking changes. The first notable feature is a totally disorderly arrangement of the glands as compared to the usual normal vertical extension from the basalis to the surface; second, there is a notable increase in the number present; and finally there is a tremendous variation in their size and shape as seen in cross section. There are also certain characteristic changes in the cells of the glands and on this basis three different varieties may be recognized. (1) *Glands with a single layer of cylindrical epithelium,* which are identical to those normally found during the stage of proliferation. At times they are branched and show various irregularities in their contour (Fig. 1). It is very important to note that glands in a state of secretion are usually absent. They may occasionally be found, but in the specimens of this series they were never as fully developed as those of the normal pregravid phase and unaccompanied with corresponding changes in the stroma. However, Schroeder (76) and Runge (71)

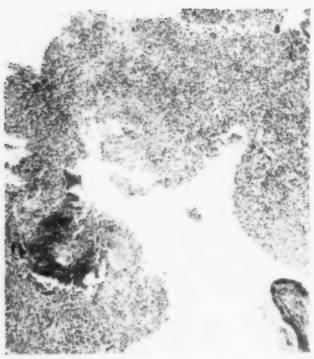

Fig. 5.

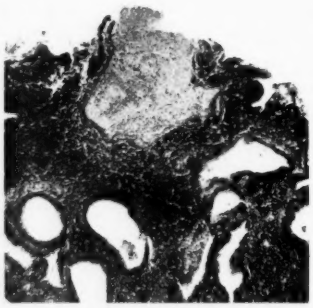

Fig. 6.

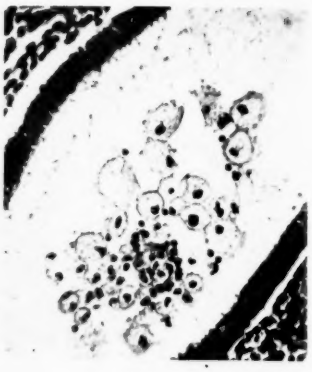

Fig. 7.

Fig. 5. Areas of necrotic tissue. (Spec. No. 7926.) x 75.
Fig. 6. Thrombosis of large blood vessel. (Spec. No. A3336.) x 75.

Fig. 7. Section showing groups of large vacuolated cells which were found in the lumen of a gland. (Spec. No. A3519-2.) x 450.

maintain that in some instances secretory changes are superimposed on the endometrium and accompany corpus luteum formation with spontaneous healing of the endometrial lesion. (2) *Cystic glands* with a low cuboidal epithelium were noted in 62 specimens and are an important characteristic of hyperplasia endometrii (Fig. 2). However, since they are found normally in the basal layer of the endometrium at any stage of the menstrual cycle as well as in certain cases of endometritis and atrophia endometrii, it would be wrong to base the diagnosis of hyperplasia on their presence alone. (3) *Glands with stratified epithelium* again reflect the marked growth activity which is so characteristic of this disease. They are usually of moderate size but sometimes are very large and on cross section are round, star shaped, or branched, and may have papillary projections into their lumina. The cells are of the cylindrical variety but form from 2 to 5 layers (Fig. 3). Mitotic figures are to be found, and these structures have at times been confused with carcinomatous changes and have been labeled as either cancer or "precancerous."

B. *Hyperplasia in bleeding cases.* The importance of recognizing the distinction between specimens of hyperplasia endometrii obtained at a time when the patient is bleeding and when she is not cannot be overemphasized, for if the curettings are taken at the time the patient is bleeding two important additional factors are found in the endometrium, namely, the presence of areas of necrosis and thrombosis of blood vessels, and, second, an extensive infiltration with leucocytes.

The presence of areas of necrosis has been described in particular by Schroeder who considers them as the result of a thrombosis of blood vessels and as the immediate factor concerned with bleeding. A number of subsequent writers have focused their attention on the occurrence of thromboses and have failed to find them as frequently as Schroeder, although they noted them in isolated instances (Seitz; Adler, 2; Novak and Martzloff; Beckman, 9). However, in more recent studies, Shaw has given special attention to localized areas of disintegration and considers this finding as one of the most characteristic features of hyperplasia endometrii, while von Mikulicz-Radecki, in his examinations of the uterine cavity with a hysteroscope, found that bleeding in these cases came from defects in the surface of the mucosa.

Forty-seven of the specimens of this series were obtained either while the patient was actually bleeding or the hæmorrhage had ceased a short time before the operation; in 24 cases hæmorrhage had not occurred for some time; and in 4 this information could not be determined with certainty from the clinical

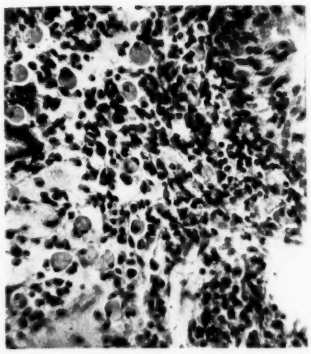

Fig. 8.

Fig. 8. The occurrence of large cells, with eccentric nuclei and resembling tissue histiocytes, have been noted in the endometrial stroma in a few instances. (Spec. No. 5128.) x 335.

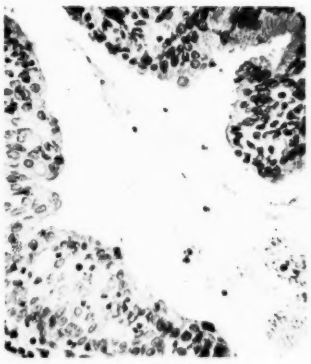

Fig. 9.

Fig. 9. Epidermidalization of the surface mucosa in hyperplasia endometrii. (Spec. No. 7104.) x 335.

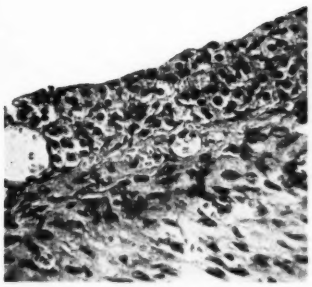

Fig. 10.

Fig. 10. Theca lutein cyst of the ovary. (Spec. No. A2968.) x 335.

history. It was now found that definite areas of necrosis (Figs. 4 and 5) could be demonstrated in 20 of the 47 patients who were bleeding at the time of the curettage or hysterectomy, and only twice in the 24 who were not bleeding when the specimen was obtained. In addition, thromboses of large blood vessels were seen in most of the necrotic regions examined, and several times in healthy tissues (Fig. 6). It is felt that this finding strongly supports Schroeder's contention that tissue disintegration occurs and is the immediate factor responsible for the hæmorrhage. The finding of 2 cases with necroses in non-bleeding patients may very well be explained on the assumption that hæmorrhage was imminent and this is borne out by one of these patients who had had cyclical bleeding and the next "period" was due. Although necroses were found in only 43 per cent of the bleeding cases, it is most important to remember that the negative finding is not conclusive in view of the technical difficulties associated with their demonstration. These were outlined in a previous study (Fluhmann, 31) and since that time the importance of this feature has been appreciated more and more in the Stanford Gynecological laboratory.

The second important finding associated with hæmorrhage in cases of glandular hyperplasia is an extensive infiltration of the tissues with leucocytes. This feature is considered as unusual by a number of previous investigators (Babes, 7; Novak and Martzloff) but in these studies apparently no differentiation was made between specimens from "bleeding" and "non-bleeding" patients. An analysis of the cases of this series, however, shows that marked infiltration of the endometrium, and especially near the surface, with polymorphonuclear leucocytes and lymphocytes was noted in 39 of the 47 bleeding cases, including all those with areas of necrosis, while it was observed only 6 times in the 24 non-bleeding patients. This observation is of interest in

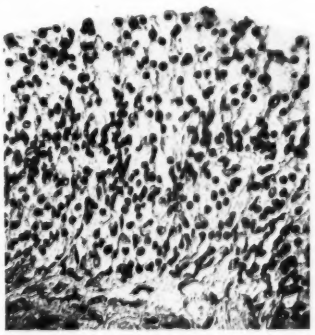

Fig. 11. Lutein cyst of the ovary found in one case of hyperplasia endometrii. (Spec. No. A3519.) x 335.

Fig. 12.

Fig. 12.

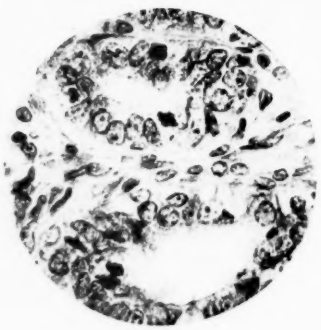

Fig. 13.

Fig. 12. (Spec. No. A6387-2 and -3.) Photomicrographs of the same magnification illustrating the marked growth of the uterine mucosa following the administration of œstrin. The left photomicrograph is of the uterus of an adult mouse castrated 4 weeks previously, while the right one shows a section of the uterus of another mouse spayed at the same time and given 30 rat units of œstrin (amniotin-Squibb) over a period of 8 days. x 70.

Fig. 13. Mitotic figures indicating growth activity of the uterine mucosa of a spayed rat following the administration of œstrin (amniotin-Squibb). (Spec. No. A6158.) x 715.

that it at once suggests the similar appearance of large numbers of leucocytes in the normal endometrium just before and during menstruation, and in the endometrium when a premature "menstruation" is induced by cauterization of the corpus luteum (Whitehouse). True inflammatory cells such as plasma cells are generally absent. Shaw has already drawn attention to large vacuolated cells which occur in groups in the lumina of the glands and considers them as degenerated epithelial cells. These were observed in a considerable number of specimens both from bleeding and non-bleeding cases (Fig. 7), but in addition certain large cells with eccentric nuclei were noted in the stroma in a few instances (Fig. 8). It would seem that the latter at least are a type of tissue "histiocyte" similar to those found in the uterus and broad ligament during pregnancy and the puerperium (Hornung; Hofbauer, 50; Fluhmann, 27; Teacher).

Epidermidalization in hyperplasia endometrii and relation to cancer. In 2 of the specimens of this series was noted a transformation of the surface epithelium to a type resembling squamous epithelium (Fig. 9). This process is of special interest in that it may lead to confusion with carcinoma and is similar to the "epidermidalization" seen in the cervix uteri in various conditions (Fluhmann, 25). Of interest also is the rare occurrence in hyperplasia of islands of cells in the deeper layers of the mucosa which closely resemble the basal layer cells of normal squamous epithelium. This condition was discussed in a previous communication (Fluhmann, 26) when one case was reported in detail. At the time the writer had found only 5 other cases in the literature, 3 of which had been regarded as carcinoma, but 2 reports had been overlooked, namely that of Aschheim with 3 cases and that of Ahlström with one case. Since then the total has been brought to 19 by Hintze, who has recently described 9 additional instances.

Although glandular hyperplasia endometrii has no direct connection with malignancy, the possibility of the co-existence of the two conditions, especially in women of the menopausal age, must always be kept in mind. This has been found on one occasion in this laboratory and was described in detail in a previous article (Fluhmann and Stephenson).

Uterine polypi. In only 1 instance of the 75 cases of this series was a cervical polypus noted and there is no reason to suspect the existence of any relation between the two conditions, since these small tumors are probably solely an accompaniment of chronic pelvic congestion (Fluhmann, 24). On the other hand, 5 endometrial polypi were found which presented a histological picture of hyperplasia identical to the uterine mucosa of each individual case.

Differential diagnosis. Although hyperplasia of the endometrium presents, as a rule, but little difficulty in histological diagnosis, it is especially to be differentiated from conditions which are associated with the formation of cystic glands, such as certain cases of senile endometrium. It is also of importance to distinguish it from "simple hypertrophy of the endometrium" which likewise presents a marked overgrowth of the endometrium and hyperæmia, but is recognized by the regular arrangement of the glands and the corresponding cyclical changes.

OVARIES

Of primary importance in the consideration of hyperplasia of the endometrium and especially in any discussion as to its etiology, are the co-existent changes which have been described in the ovaries of these patients. Since the first discussion of this aspect of the problem by Brennecke in 1882, R. Schroeder and R. Meyer have offered the most outstanding contributions to this question.

Schroeder's first papers on the subject appeared in 1915 (73) and 1919 (74), and in 1928 he published his final observations in Veit-Stoeckel's *Handbuch der Gynaekologie* (76). He has made complete examinations of both ovaries and the uterus in a total of 62 cases of glandular-cystic hyperplasia of the endometrium. In no case was he able to find a mature corpus luteum, and in 53 specimens the ovaries contained one or more small cysts, which on microscopic examination were seen to be lined by well-preserved granulosa and theca layers indistinguishable from a normal ripening follicle. In a few instances he was able to demonstrate the presence of the ovum in the granulosa layers of the cyst, and only occasionally was there any evidence of degeneration of the granulosa with beginning hypertrophy of the theca. In 9 cases were follicles undergoing degeneration, and in addition a very early corpus luteum was seen in 3 of these specimens. The histological picture of the endometrium in these 9 cases was essentially the same as in the first large group, although the process of disintegration was more marked and in some instances very early evidence of secretion could be seen in the glands. On the basis of these observations Schroeder developed his theory regarding the nature of hyperplasia, that the endometrial change is directly due to a stimulation from a "pathological persistence of a ripening follicle," that is, ovulation does not occur and the ovum does not die but persists in the follicle which continues to function. After a time the ovum dies and if a similar persistent follicle does not arise, the endometrium atrophies or is cast off, and spontaneous healing takes place.

The findings which R. Meyer published in 1920 (57) substantiated the absence of corpus luteum formation which Schroeder had reported although he felt that this condition was only applicable to a certain number of cases of hyperplasia, and he also gave a different interpretation to the cystic structures present in the ovaries. Although he noted cysts with a normal granulosa he also found large cysts due to follicle atresia and with unusual hypertrophy of the theca cells (granulosa-epithelial lutein cysts). He, therefore, did not accept Schroeder's conception of a persistent functioning follicle. His interpretation is that the follicle does not reach complete development and that the ovum dies prematurely. This follicle then undergoes atresia, and another immediately begins to develop and undergoes the same process. His conception is thus similar to Brennecke's except that he does not consider the thickening of the albuginea as the cause for the absence of ovulation, but attributes it to an inherent weakness of the ovum in the process of development. Although there is some difference in the two theories as regards the significance of the ovarian changes, the basic effect remains the same since in both cases there is a prolonged stimulation to the endometrium.

The ovarian findings reported by Schroeder and Meyer have been corroborated by a number of subsequent investigators, except for a few isolated instances of the co-existence of hyperplasia endometrii and mature corpora lutea. Seitz described a few cases of hyperplasia in which the ovaries presented abnormal lutein structures, which he felt must be considered as incapable of functioning in the same manner as the normal yellow body. Babes (7), in Meyer's laboratory, analyzed 25

complete specimens and found corpora lutea in 3 instances, 2 of which he described as of about 3 weeks' development and the third as in the stage of vascularization. As Schroeder (76) observes, however, the description given for the endometrium in these cases makes one doubt if the author was actually dealing with the same condition described in his work and in this paper. Novak and Martzloff were able to obtain only incomplete ovarian material, but nevertheless found mature corpora lutea accompanying hyperplasia endometrii in 4 instances. Shaw, in a more recent study, examined both ovaries in 12 cases and found in most instances atrophied organs with unilateral cysts which generally proved to be cystic ripening follicles. In 2 cases he found that follicle rupture had recently occurred, and in one he noted a recent corpus luteum. Since the endometrium in the latter case "showed corresponding cyclic changes" it would seem that here again the author was dealing with a condition which is not identical to that considered in this study. Beckman also found 3 specimens with mature corpora lutea but these cases were unaccompanied by the profuse hæmorrhages generally associated with hyperplasia.

Of special interest in this phase of the problem is the occurrence of hyperplasia endometrii in the postclimacteric period and in association with ovarian new-growths, chiefly granulosa cell tumors, but also fibromata and sarcomata. In 1922, Schroeder (75) described one such case and Moulonguet-Doléris made similar observations in two instances in 1924. Since then a considerable number of cases have been reported, for instance by R. Meyer (58), Neumann, Isbruch, Babes (8), Tietze, Schroeder (76), Frankl, Robinson.

Owing to the conservatism in dealing with the ovaries which is practiced on the Stanford Gynecologic service, only a few cases are available in which both ovaries were removed. Three of these are from patients of this series, a fourth (No. A2968) is from a previously reported case of hyperplasia associated with a very early carcinoma (Fluhmann and Stephenson), while the fifth is a patient who had had a previous unilateral oophorectomy, so that the examination of the remaining ovary at the time she had hyperplasia may be considered as representing the complete ovarian picture. The details of these findings are as follows:

Specimen 3256. Patient was 36 years of age. The left ovary contained two small cysts, the larger measuring 1.5 centimeters. One of these was lined by well preserved granulosa cells and a markedly hypertrophied theca (theca-lutein-granulosa cyst); the second was a similar cyst; there was only slight hypertrophy of the theca cells here and there. A small fibroma was present in one pole of the ovary. The right ovary did not show anything beyond a few primordial follicles.

Specimen A2968. Patient was 44 years of age. Both ovaries contained a number of small cysts. The left showed two atretic cysts with a fibrous tissue lining, one cyst with a well preserved granulosa cell lining, and two early developing follicles. The right showed two atretic cysts lined with fibrous tissue and one large theca lutein cyst (Fig. 10).

Specimen A5075. Patient was 49 years of age. One ovary had been removed 19 years before, and the present specimen showed numerous corpora albicantia, one granulosa cyst similar to those mentioned above, and a small serous cystadenoma.

Specimen 8015. Patient was 36 years of age. The left ovary contained a theca lutein cyst and the right a fibroma.

Specimen A1581. Patient was 51 years of age, 2 years past the menopause. The left ovary showed a granulosa cell carcinoma, while the right was a small sclerotic senile structure.

It is thus seen that no evidence of a recent corpus luteum was noted in a single instance. In 3 cases follicle cysts with a well preserved granulosa cell layer were found, a fourth case showed a fibroma ovarii on one side and a theca lutein cyst on the other, while the fifth was from a patient 2 years past the menopause and showed a granulosa cell carcinoma. In addition, a careful inspection of both ovaries in the course of a laparotomy in 2 recent cases failed to show any structures which could be recognized grossly as corpora lutea, and in one of these cases numerous small cysts in each ovary were opened with the thermocautery. In another patient who had had one ovary removed one year before, the remaining ovary was found to be the size of a large walnut and to contain two small cysts. One of these was resected and histological examination showed the lining to be composed mainly of three to five rows of large theca lutein cells as in Figure 10, but in certain

areas the lutein cells were smaller and formed from 10 to 15 rows, and there was no fibrous tissue formation (Fig. 11).

The remaining available material from the patients of this series cannot be considered as of importance and need only be mentioned briefly. In 1 case both ovaries were obtained, but since the patient had been treated with radium a few weeks before the operation, no finding could be taken as necessarily characteristic of hyperplasia. In 9 of the cases only one ovary had been removed and in a study such as this the value of incomplete material is very doubtful. No corpora lutea were noted but three types of cysts were found —follicle cysts with well preserved granulosa cells, atretic follicles with a degenerating granulosa layer and fibrous tissue formation, and theca lutein cysts. In one instance a small fibroma was present in one pole of the ovary.

FUNCTIONAL STUDIES

An important development resulting from the epoch-making discoveries in the sphere of the sex hormones during the past few years has been the elaboration of biologic tests for certain endocrine substances which are vital factors in normal and abnormal ovarian and uterine function. The two main tests are those for the sex factors of the anterior hypophysis (Aschheim-Zondek) and for the œstrus-producing ovarian hormone (Allen-Doisy). The employment of these tests in studying patients with disturbances of menstruation is a great advance and their importance is as yet but little appreciated.

Although the Aschheim-Zondek test has been almost completely limited to its use as a "pregnancy test" there is very good evidence that it may prove of considerable value in the study of other conditions. For the past 2½ years a modification of this test which requires the examination of blood serum for the presence of unduly large amounts of anterior pituitary sex hormone has been employed in over 400 patients in the Stanford Gynecological laboratory. It has been shown that outside of pregnancy the blood of patients may contain large quantities of the anterior hypophyseal "ovulation hormone" and thus suggest a hypersecretion of this gland (Fluhmann 29, 30, 32). Although this procedure as a clinical test is as yet in its infancy and it is not certain if it truly represents pituitary hyperfunction, it has been found reliable in conditions such as following castration and during pregnancy when a hypertrophy of the anterior hypophysis occurs, and conversely I have never obtained a positive result in a woman with normal menses.

It seemed of importance to examine the blood of patients with hyperplasia, especially since this condition is prone to occur at the time of the menopause when a fairly high percentage of women have yielded positive results. Ten patients have been examined, and in every instance the diagnosis had been established by a histological examination of the endometrium. The ages were 23, 33, 38, 39, 40, 41, 44, 45, 49, and 50 respectively. In one case, a woman of 44, the test proved positive, but in the other 9 it was definitely negative so that this feature cannot be considered as a characteristic of the disease.

Of still greater importance are the studies which have been made on the presence of œstrin in the blood or urine of these cases and we are chiefly indebted for this information to Frank, Zondek, and two investigators in Schroeder's clinic, Siebke and Schuschania. Frank has examined the venous and uterine blood of 7 young patients with "puberty hæmorrhage" in whom cystic hyperplasia of the endometrium was demonstrated by curettage, as well as a few women in the preclimacteric period who presented the same endometrial lesion. The blood escaping from the uterus in these cases contained a demonstrable amount of female hormone, "thus differing strikingly from the uterine blood obtained in adult menorrhagias or metrorrhagias. This probably signifies a high degree of ovarian activity" (page 238). In one of the young patients the urine also contained an unusually large amount of the hormone. The examination of the venous blood, however, regularly showed an absence of even a single mouse unit in 40 cubic centimeters. In this regard it is important to note that these blood examinations were apparently made following long periods of uterine bleeding, and the significance of the negative find-

ings will be appreciated later in the light of Siebke's results.

Siebke has made 19 observations on 16 patients with glandular hyperplasia endometrii following the technique described by Frank and Goldberger and employing 20, 40, or 60 cubic centimeters of blood. On ten occasions positive results were obtained and of these, 3 patients were not bleeding at the time of the examination, 4 had been bleeding for 9 days or less, and 3 for from 2 to 4 weeks. On the other hand, negative results occurred in 9 instances and in every case bleeding had been present for periods varying from 2½ weeks to over 3 months. It is thus seen that during the interval of non-bleeding and during the first few days of bleeding, a large amount of œstrin is found in the circulating blood. Zondek (91) has also observed large amounts of œstrin excreted in the morning urine of such patients, especially during the amenorrhœic phase ("hyperhormonal amenorrhœa"), and an examination of the follicles in these cases showed that they exceed by 3 to 5 times the normal follicles in both size and hormone content.

The study of Schuschania is of special interest in that it clearly demonstrates the association of œstrin production with hyperplasia of the endometrium in the postclimacteric period. The patient was 65 years of age, 7 years past the menopause, and had a granulosa cell tumor of the ovary with hyperplasia of the endometrium. An estimate of the total hormone output over a period of 5 days preceding operation showed that 326 mouse units of œstrin were excreted in the urine and 619 in the fæces. A similar study was conducted for 8 days a short time after the operation but only 158 mouse units were present. Two months after the operation an analysis of both urine and fæces proved negative. He also found a demonstrable amount of œstrin in 5.0 cubic centimeters of blood obtained from a vessel in the capsule of the tumor.

OVARIAN HORMONES, HYPERPLASIA ENDOMETRII

The investigations which have been carried out in recent years on the ovarian hormones (Frank, E. Allen, Doisy, Aschheim, Zondek, Parkes, Corner, W. M. Allen, Hisaw, and numerous others) have served to point out two very distinct effects on the endometrium which are normally manifested during the course of the menstrual cycle (see Fluhmann, 33). In the first place there is a set of changes initiated and maintained by œstrin (ovarian follicular hormone) which consists chiefly of an orderly growth of the glands and stroma from the permanent non-changing basal layer, and at this time the stroma is dense and the cells are spindle shaped, while the glands are straight, with the lumina clearly outlined. Toward the middle of the menstrual cycle (tenth to eighteenth days), another factor comes into play, namely a second hormone manufactured by the corpus luteum (termed "progestin" by Corner and his associates) which results in a definite transformation of the cells of the stroma and of the glands of the endometrium to constitute the so called premenstrual or pregravid phase. The cells of the stroma have now hypertrophied and become "decidua cells" while the glands are markedly tortuous, their lumina are irregular and indistinct, and they are filled with secretion.

It is of importance to interpret hyperplasia endometrii in these terms, as they give a fundamental explanation for the manifestation of this disease, namely, an *overstimulation of the endometrium by œstrin and a complete absence of progestin influence*. This conception is in keeping with Schroeder's teaching and the evidence for it is based on a number of important observations: (1) there is an extensive production of œstrin in women with hyperplasia endometrii, (2) the absence of mature corpora lutea precludes the formation of progestin, (3) œstrin is a growth stimulus to both endometrial glands and stroma, and in hyperplasia the endometrium has the histological characteristics which result from this type of stimulation, while (4) there is an absence of the endometrial changes which normally are produced by progestin.

1. The massive production of œstrin ("hyperœstrinism") accompanying hyperplasia endometrii is shown by the demonstration of large amounts of this substance in the venous and uterine blood, urine, and fæces of these patients, as well as in the follicle cysts.

2. There is outstanding evidence that in hyperplasia the ovaries show functioning fol-

licle cysts and a complete absence of mature corpora lutea. The finding of these histological structures in a few instances is not necessarily proof that they are functionally identical to the normal yellow body and are capable of producing progestin. Wiesner and Crew have drawn attention to the occurrence of corpora lutea in lower animals without the manifestation of their characteristic effects on the uterus unless another factor is added. It is also important to remember that the normal human corpus luteum manufactures both œstrin and progestin, and since these two substances are antagonistic it is conceivable that at times the œstrin may completely overshadow any progestin influence.

3. The fact that œstrin is a powerful growth stimulus to the uterine mucosa in small laboratory animals, in monkeys (Allen and co-workers, 4, 5, 68), and in the human (Zondek, 90) has been conclusively shown by numerous investigations in castrates (Figs. 12 and 13). It has also been found that the endometrium of monkeys given œstrin (Allen et al) shows the presence of only very early secretory changes in the glands. This is similar to the human endometrium normally seen during the stage of proliferation when the corpus luteum has not yet begun to function and in monkeys which have menstrual periods in the absence of ovulation and corpus luteum formation. The type of glands and stroma in hyperplasia is of this nature, except for the fact that they have undergone excessive growth, and in this regard it is of interest that following the administration of large amounts of œstrin Clauberg has observed a stratification of the cells in the uterine glands of the mouse which is not unlike that seen in the human in hyperplasia endometrii.

4. The endometrium in hyperplasia never shows fully developed pregravid changes in the glands and stroma, a process which is controlled by a second hormone of the corpus luteum (Corner and Allen; Hisaw and Leonard). The occasional occurrence of a gland with early secretory changes is not only explainable on the assumption that spontaneous healing is taking place (Schroeder 76, Runge), but as already pointed out, a similar *early* stage of secretion has also been found in spayed monkeys as the direct result of œstrin stimulation.

CAUSE OF BLEEDING

The occurrence of "hyperœstrinism" may readily account for the marked growth activity manifested by the endometrium in glandular hyperplasia, but on the other hand it is necessary to seek further afield to discover any factors that may be held responsible for the hæmorrhages accompanying this condition. In a previous study (Fluhmann, 31) the mechanism of bleeding from the endometrium was discussed, and it was pointed out that it may occur as the result of one of two distinct processes, namely, bleeding per rhexis or bleeding per diapedesis. The first of these, that is hæmorrhage from actual injury to the vessels, may be brought about in one of several ways, namely, as the result of (1) a massive desquamation of the functional layers of the endometrium such as occurs in normal menstruation; (2) a localized necrosis of smaller or larger areas of the mucosa; (3) the rupture of an isolated superficial vessel; or (4) the formation of small pools of blood beneath the surface due to the rupture of a deep vessel and leading to a loss of continuity and the formation of an open wound.

It is felt that the chief local factor producing hæmorrhage in cases of hyperplasia endometrii is the occurrence of tissue disintegration, although another possible cause is a traumatic injury to the large superficial vessels which are so frequently present (Seitz). In seeking for a hormonal explanation for the onset of necrosis, two different possibilities arise, and each is applicable to one of the two different clinical manifestations of the disease. There is first the group in which one finds a definite cyclical appearance of bleeding, and, second, those cases in which there is a prolonged, continuous or intermittent, hæmorrhage lasting for periods of weeks or even months.

In considering the first group, one is tempted to draw a comparison with the cyclical hæmorrhages of "normal menstruation," and there are several points of similarity besides the clinical demonstration of a "cycle." In both instances there is a spontaneous tissue destruction with a consequent growth and re-

pair. The uterine blood in both cases contains large amounts of œstrin, although this is not met with in metrorrhagias from other causes (Frank, Siebke). And finally, it suggests a possible reversion to a primitive type of menstruation which has been described in various species of monkeys (Heape; Herwerden, 45; Corner 16, 17; Allen; Hartmann), and which is not accompanied by follicle rupture and corpus luteum formation. The endometrium here corresponds to that seen during the stage of proliferation and the "menstrual flow" sets in accompanied by a tissue destruction and desquamation of the superficial layers.

This conception is particularly attractive because it affords a logical hormonal explanation for the onset of the hæmorrhage. For many years investigators have sought to explain the uterine bleeding of menstruation by calling in some obscure "toxin" which would destroy the uterine mucosa. It would seem, however, that bleeding is produced in exactly the opposite way, namely, that it results because of the *removal* of ovarian influence after it has stimulated endometrial growth. This has been shown mainly in four ways. (1) Normal menstruation sets in at the same time that degeneration of the mature corpus luteum occurs. (2) The excision or destruction of a functioning corpus luteum or mature follicle is followed within a comparatively short time by uterine bleeding, both in humans (Fraenkel, Pychlau, Halban and Koehler, Whitehouse) and in monkeys (Hartmann). (3) Although the peak of œstrin formation occurs a few days before menstruation, the blood of women at the time the menses set in does not contain a demonstrable amount of this hormone (Frank, Siebke), thus suggesting a diminution or a cessation of its production. (4) The discontinuance of prolonged administration of œstrin to human castrates (Zondek, 90) or to spayed monkeys (Allen and co-workers 4, 5, 68) results in uterine bleeding and the endometrial picture is of a breaking down of the mucosa which had been stimulated to active growth.

On the basis of this information a theory in regard to the whole clinical picture of hyperplasia endometrii might be conceived as follows: There is a cyclical development and atrophy of follicles which fail to ovulate. At the time that the ovum is alive and the granulosa cells are active there is an overproduction of œstrin with a resultant hyperplasia of the endometrium. With the death of the ovum there is an atrophy of the follicle, a cessation of œstrin formation, and hence tissue disintegration in the uterine mucosa with consequent hæmorrhage.

Such a theory would tend to support Meyer's interpretation of the ovarian findings and would not be at all inconsistent with that of Schroeder. However, there are unfortunately five serious objections. In the first place, although the process of tissue necrosis in hyperplasia has many points of similarity with the desquamation of normal menstrual endometrium, it is more irregular in that the disintegration takes place here and there, in smaller or larger areas, instead of producing a wholesale destruction. Second, Siebke found œstrin in the venous blood at the time hæmorrhage set in, and since it is absent when normal menses occur it would seem that in hyperplasia there is not the same sudden cessation in the production of this hormone. Third, in the cases of "menstruation without ovulation" in monkeys the endometrium has not undergone an overgrowth as in hyperplasia in the human but on the contrary has developed to a less degree. Fourth, it is not applicable to the cases of hyperplasia which accompany ovarian new-growths. And finally, it does not account for the second and largest clinical group of cases in which the hæmorrhage is prolonged and irregular in occurrence instead of appearing cyclically.

The second possibility to account for the formation of necroses in hyperplastic endometrium is that suggested by Schroeder (76), namely, that, following prolonged and excessive stimulation to the endometrium, degenerative changes eventually set in which affect the blood vessels. As a result, numerous small thromboses with subsequent infarct formation and necrosis take place and produce irregular or continuous uterine bleeding. Although there is as yet no experimental data which clearly demonstrates that the constant stimulation by œstrin leads to this effect, this explanation is strongly supported by both clinical observation and histological investi-

gation. It readily accounts for the non-cyclical hæmorrhage which occurs in two-thirds of the patients with hyperplasia endometrii and is particularly applicable to those cases accompanying ovarian new-growths during the post-climacteric period.

It would seem that this aspect of the problem must remain *sub judice* for the present. However, the co-existence of both the factors discussed above, namely, necrosis due to cessation of œstrin stimulation and due to *prolonged* incessant stimulation, must be kept in mind as a possibility.

ETIOLOGY

Although some progress has been made in determining the nature of hyperplasia endometrii nothing definite is known as yet regarding its etiology. It has been conclusively shown that this condition *per se* has nothing to do with infection, and although it is still stated that local pelvic factors which induce a hyperæmia may lead to hyperplasia endometrii the evidence advanced has not been very convincing. As has been outlined in this paper, the endometrial changes merely represent a response to an ovarian dysfunction, and the problem is to determine whether the ovary is the primary organ involved or whether it is affected by some external influence.

In view of the work of Evans, Smith, Engle, Aschheim, and Zondek demonstrating the "ovary-stimulating" properties of the anterior hypophysis one's attention is at once directed to this organ. However, if the anterior lobe is directly concerned with hyperplasia endometrii, it is impossible as yet to state whether this involvement is in the nature of a hyperfunction, a hypofunction, or a disturbance in the relationship of the two hypophyseal sex factors.

Hofbauer (51) has recently found that following either bovine anterior hypophyseal implantations or the administration of an alkaline extract of this gland to mature guinea pigs a large number of atretic follicles are found in the ovaries and the uterine mucosa gives evidence of marked proliferation. On the basis of this finding, he has advanced the theory that a hyperfunction of the anterior lobe is responsible for hyperplasia endometrii, and suggests the name of "hyperplasia endometrii pituitaria" for the condition. This contention is also supported by the fact that at the time of the menopause when hyperplasia most frequently occurs, large amounts of the anterior pituitary "ovulation" hormone are often found in the blood (Fluhmann, 32) and urine (Zondek, 92) of women, while Hofbauer (49) has reported that X-radiation of the hypophyseal area with a resultant diminution in the activity of the gland has a beneficial effect in certain cases of abnormal uterine hæmorrhage.

On the other hand, there are several objections to the theory that a simple hyperfunction of the anterior hypophysis leads to hyperplasia endometrii. (1) It is doubtful if in this problem experiments on animals with an œstrous cycle can be accepted as directly applicable to humans with a menstrual cycle. As pointed out by Wiesner and Crew and others, certain laboratory animals (rats, mice, guinea pigs) are "diphasic" in that normally the sex cycle is controlled solely by œstrin (the "œstrual" phase), while the second ("reproductive" phase) which is the result of progestin stimulation, occurs only in the case of gestation or pseudo-pregnancy. On the other hand, in the human cycle both phases are represented since a pregravid transformation ("pseudo-pregnancy") occurs before each normal menstruation. Thus an ovarian stimulation with anterior lobe substances may merely intensify the œstrual change in the uterus of diphasic animals and result in a hyperplastic uterine mucosa, but this does not prove that there is an abeyance of the progestin element as well, a feature which is prominent in the human hyperplasia endometrii. It has in fact been shown that the administration of anterior hypophyseal fluid aids the placentoma reaction of adult virginal rats (Teel, Brouha), thus suggesting that instead of suppressing the "reproductive" element of the cycle in these animals, it may stimulate it. (2) There are individual specie variations in ovarian response even in different laboratory animals, for Smith and Engle have shown that prolonged stimulation of mature mice and rats with anterior lobe implants produced quite different results. In the rat ova-

ries there were numerous atretic cysts and theca lutein cysts, but these were not noted in mice. In both instances corpora lutea were formed and the animals would mate. (3) There is some evidence that an excessive production of the sex hormones of the anterior lobe may lead to quite a different result from hyperplasia, namely, to an accelerated formation of normal follicles and corpora. Smith and Engle found this to be the case in adult mice treated with implants over a prolonged period, and it has been shown elsewhere (Fluhmann, 32) that in the human there occur certain conditions in which the examination of the blood shows the presence of large amounts of the anterior pituitary "ovulation" hormone, and clinically the patients are found to have too frequent and too profuse menses. In these cases follicle ripening, ovulation, and corpus luteum formation occur and the mucosa conforms to the normal cyclical changes. It is thus not a hyperplasia endometrii as understood in this study but a "simple hypertrophy of the endometrium." (4) And finally, the examination of the blood of 10 patients with hyperplasia endometrii has only demonstrated the presence of large amounts of the anterior lobe sex hormones in one instance, and it would seem that if this condition were due to a pituitary hyperfunction one would have obtained positive results more frequently, as has been the case in women following castration or during pregnancy.

It would seem that an accurate scientific explanation for the occurrence of hyperplasia endometrii will be given only when more is understood regarding follicle rupture and corpus luteum formation. It is also probable that a more complete knowledge of the factors concerned in the "menstruation without ovulation" of monkeys will be of much significance.

TREATMENT

The methods of treatment which have been employed for the patients of this series are in keeping with the recommendations previously given by most authors on the subject, and do not offer anything unusual. The procedure of choice in younger patients has been to perform a curettage. In a group of 17 who were seen for a period of at least 1 year following the curettage it was found that 7 were completely relieved of their symptoms; 3 within 2 months of the operation had a short period of bleeding which cleared up spontaneously and the patients were well afterward; 2 were well for a few months but had a recurrence within 1 year; 3 were unimproved; and in 2 no interval history was available but it is known that the bleeding was again present 2 years after operation. In the case of recurrences it is generally recommended to repeat the curettage, but if this is ineffective and the bleeding becomes altogether uncontrollable it may be necessary to perform a hysterectomy. In one instance the patient had a retroversio uteri with symptoms. A curettage was performed, followed by a suspension of the uterus and during the laparotomy numerous small cysts in both ovaries were punctured with the thermocautery. The patient has remained well for 2 years but it is not felt that this method of treatment is to be recommended.

The treatment of choice in patients of the menopausal age is to perform a diagnostic curettage and give an intra-uterine application of radium varying between 1,200 and 1,500 milligram hours. This procedure in our hands has given universally good results.

Although a number of reports have been published regarding the use of various hormone preparations in this condition this type of therapy with biologically active products is as yet in the experimental stage. It is possible that the development of an extract of the "luteinization" factor of the anterior lobe or the placenta will be of value. Owing to the fact that this disease is characterized by an overproduction of œstrin, it is illogical to administer this ovarian hormone to patients with hyperplasia endometrii (Schroeder, 77; Siebke).

SUMMARY

Hyperplasia endometrii is the name given to a characteristic lesion of the endometrium which should not be considered as a purely local change but as part of a definite clinicopathological entity.

It was found in 2.8 per cent of the last 1,700 hospital admissions on the Stanford Gyneco-

logical service, and accounted for 12.2 per cent of patients in a series of 507 women with abnormal uterine hæmorrhage.

It may occur at any time during the active sexual life of women and has been observed in the postclimacteric period, but the majority of cases are found just before and during the menopause. Approximately 75 per cent of the patients were multiparæ.

The outstanding symptom of the disease is uterine hæmorrhage, which is manifested mainly in two ways: (1) Periods of profuse bleeding occurring at cyclic intervals, and (2) prolonged, continuous or intermittent, hæmorrhages.

No relation between hyperplasia endometrii and systemic disease was established, but in about 30 per cent of the cases, there was an associated pelvic condition.

The endometrium is characterized by a marked hyperplasia of both glands and stroma. There is an absence of the corresponding cyclical changes of menstruation and a disorderly arrangement of the glands, of which 3 main types are seen: (1) glands lined by a single layer of cylindrical epithelium; (2) cystic glands with a low cuboidal epithelium; and (3) glands with a stratification of the cylindrical epithelium. In specimens obtained at the time a patient is bleeding may be seen in addition areas of necrosis, thrombosis of blood vessels, and infiltration with leucocytes and lymphocytes.

Epidermidalization is occasionally noted and may give rise to confusion with carcinomatous changes. A co-existence with carcinoma has been described.

The ovaries of patients with hyperplasia endometrii characteristically show the presence of cystic ripening follicles, atretic follicles, and theca lutein cysts, and there is an absence of mature corpora lutea. A number of cases with ovarian new-growths have previously been described, and one additional instance of granulosa cell carcinoma is herein reported.

Functional studies have demonstrated an excessive production of œstrin during the course of this disease, and the name "hyper-œstrinism" is suggested to describe this condition. In only one case out of 10 was it possible to find large amounts of the anterior pituitary sex hormone in the blood.

Evidence is advanced suggesting that hyperplasia endometrii is the direct result of an overstimulation of the endometrium by œstrin and the complete absence of progestin influence.

The chief local factor producing hæmorrhage is the occurrence of areas of tissue disintegration. Two possibilities regarding the induction of necrosis in the endometrium have been discussed, namely: (1) a sudden cessation of œstrin production, such as would occur consequent to the death of the ovum and atrophy of the follicle; and (2) a *prolonged excessive* œstrin stimulation such as would result from the persistence of cystic ripe follicles.

The etiology of this disease is as yet obscure but it is evidently the result of an endocrine disorder rather than a local pelvic condition. The possible involvement of the anterior hypophysis is considered.

The use of repeated curettages in younger patients and intra-uterine radium applications for women of the menopausal age are recommended as the most satisfactory methods of treatment evolved to date.

My thanks are due to Professor Robert Schroeder for his kindness in personally demonstrating many of his valuable specimens of hyperplasia endometrii and for permission to study the Kiel material; to Doctor Harald Siebke for information regarding his studies on œstrin; and to Mr. Pierre Lassègues for his technical services.

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THE INTERRELATIONSHIP OF THE PITUITARY TO THE ENDOCRINE SYSTEM WITH REMARKS ON THE TREATMENT OF PITUITARY DISORDERS

BASED UPON OBSERVATIONS IN A SERIES OF THREE HUNDRED AND THIRTY-FOUR CASES[1]

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REVIEWING the notes of some 334 cases of pituitary lesions in the human subject, one is impressed at once with the extraordinary variations in the clinical expression of the disordered gland. I doubt whether any gland or organ of the body presents so many problems for study and observation and from so many angles. Of course, as surgeons, we have a very vital interest in the pituitary body since of intracranial tumors *en masse*, tumors of this structure comprise almost 20 per cent. But, of the clinicians, the internist, the obstetrician, the ophthalmologist, the neurologist in their every day rounds cannot escape the practical problems which concern the pituitary body; and of the laboratory group, the anatomist, the chemist, and the physiologist, interested in research, find here a fascinating field for investigation.

It is not surprising, because of the many ways in which the hormones of the pituitary body influence the function of other glands and vice versa, that the clinical syndromes are so varied and versatile, and the problems involved offer so many avenues of approach and interest.

It has been claimed recently that the anterior lobe possesses two hormones, one a growth hormone and one having maturity provoking function (Loeb and Bassett). Further differentiation has been established in that the growth factor is believed to be a product of the eosinophilic cells while the basophilic cells are related more specifically to the gonads. One of these hormones stimulates growth of the thyroid gland.

The information available from the experimental laboratory as to the interrelationship between the pituitary and the other glands of the endocrine system is abundant, much more abundant than the available information as to any other gland. To emphasize the importance of the pituitary from this angle, may I venture to recite a few of the observations which have been made in the past five years alone.

Perhaps the most intimate relationship and the most constant is with the thyroid gland. Thyroid deficiency conditions a consistent hypertrophy of the hypophysis in the male though not in the female. The size and the activity of the pituitary is specifically related to the activity of the thyroid, when this exceeds the usual limits in either direction, although its growth response to thyroid deficiency does not parallel the body as a whole (Hammett). It has been said that the anterior lobe is the specific agent which stimulates the thyroid gland (Uhlenhuth). Partial extirpation of the thyroid and adrenals in the parents will be followed by an increase in the pituitary to two or three times its normal size in the offspring (Seitz and Leidenius).

It has been suggested that the determination of pituitrin sensitivity may be of aid, as with adrenalin, in the diagnosis of hyperthyroidism (Herzum and Pogany).

Embryologically, of course, this relationship is very close, both structures being formed from a mass of epithelium split off from the pharynx. It might be of interest to note that a larger mass goes to the thyroid in women than in men. Whether this has any relationship to the greater frequency of various forms of goiter in women than in men is an interesting speculation (J. H. Hutton).

Definite and constant as the relationship between thyroid and pituitary has been proved in lower forms of life, it has been a matter of surprise to me that in the various dysfunctions of the pituitary gland in the human, one so seldom finds any evidence of thyroid involvement. In my entire series I recall but 2 or 3 cases of goiter, one of them

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a case of Basedow's disease. Whether the accession in weight characteristic of pituitary hypofunction can be attributed to hypofunction of the thyroid is a matter of speculation. Redlich believes the vegetative nervous centers and the endocrine chain are intimately related and interactive, the vegetative centers exerting a regulating and activating influence on the endocrine system, and the secretion from the pituitary in turn influencing the vegetative centers.

Many observations have been made on the effect of removal of the parathyroids, but the results are not nearly so constant as after thyroidectomy. Certainly there is no specific growth relation between the parathyroid and the pituitary structures.

From the clinical viewpoint one would expect evidence of interreaction between the pituitary and gonads. We have so constantly observed that in the female one of the earliest symptoms of pituitary disorder, antedating by many years any other suspicious evidence, is amenorrhœa. Impotence in the male, while in my series not infrequent, usually appears as a later symptom and is not observed until a diagnosis may be established by other symptoms of longer duration.

In a review of 50 consecutive cases of pituitary tumors from my clinic, Puestow found in every case but one of adenomata in women, amenorrhœa was a symptom and frequently the first symptom. The frequency of amenorrhœa suggests the residence in the anterior lobe of an inhibitory hormone. In fact Zondek is inclined to believe that the primary hormones for the sex organs is a pituitary product. In this series of 50 cases, of the males in one-half there was loss of libido and potentia irrespective of the character of the tumor.

In the lower animal castration causes an increase in weight and volume and characteristic histological changes in the pituitary, and after removal of the ovaries the eosinophils are increased. It has been said (Siegert) that the secretion of the posterior lobe of the pituitary is regulated by the ovary (Berblinger). There is no question in the lower animals that during pregnancy the anterior lobe of the hypophysis hypertrophies (Seitz) and the relationship between the pituitary and pregnancy in the human have long been recognized. The secretion of the ovary has a definite specific stimulating effect in promoting pituitary secretion (Dixon and Marshall).

Is there an interassociation of the action of the adrenals and the pituitary? This question arose in one of my series in which there were signs of acromegaly and marked hypertension. This was a case of pituitary dysfunction with hypertension and thyroid intoxication.

Mrs. J. L. C., aged 45 years, was admitted to the Neurosurgical Service December 11, 1913, complaining chiefly of headache, enlargement of hands, of the jaws, and thickening of the lips and tongue. The case was diagnosed as acromegaly. Her systolic pressure varied from 180 to 240. She was placed on pituitary extract. Later she developed signs of exophthalmic goiter with exophthalmos, certain nervous phenomena, and enlargement of the thyroid gland. The patient was under observation at intervals until she died in June, 1924.

Experimentally the removal of the adrenals with the thyroid causes a pronounced increase in the size of the hypophysis, and after bilateral adrenalectomy (Lehmann) there is a marked œdema of the pars nervosa. There is unquestionably a functional relationship between the pituitary and suprarenal cortex as might be expected on embryological grounds. The suprarenal cortex, differing from the medullary portion, is derived from the mesothelium as are the sex glands. Aplastic states of the pituitary are concomitant with aplasia of the suprarenal cortex and hyperplasia of one with hyperplasia of the other (Moehlig).

There has been some question as to whether there is such a thing as antagonism between the endocrine glands. The thyroid and pituitary are regarded by many as synergists and directly opposed to the pancreas. Others emphasize the sensitizing action of pituitrin on adrenalin and consequently the antagonistic action of pituitrin on insulin. The pancreatic secretion increases after insulin and decreases after pituitrin injection. It has been assumed that hypopituitarism produces a hypopancreatism and, vice versa, a rise of insulin in the blood increases the quantity of pituitrin as without this, protective correlative hypoglycæmia and death would occur.

Of the unusual manifestations of pituitary disorder in the human is pituitary cachexia or

Simmond's disease. In my clinic there was one very striking example of this in a boy of 15 years.

J. B. T., aged 15 years, male, was referred to the Neurosurgical Clinic by Dr. W. G. Spiller and Dr. J. W. McConnell, on December 17, 1925, complaining of paroxysmal headaches and vertigo. Family history was negative. He had had most of the children's diseases, and his growth up to his ninth year had been undisturbed. Since that time there had been little if any growth. From the age of 9 years (1919) until 2 years ago (1923) he had been apparently well. He then began to have headaches, referred to the occipital region, which occurred at intervals at any time of the day, were of variable duration, and caused a queer sensation in the head, which he called dizziness.

Physical examination revealed a small, thin boy with dry, rough skin which suggested dehydration, although he admitted drinking a fair amount of water. He had the facies of an adult. The upper extremities were thin and ill developed.

Pituitary stigmata. The external genitalia were underdeveloped. There was no axillary or pubic hair. The thyroid was not palpable. In the spring of 1925, the patient weighed 96 pounds but since that time he had lost from 23 to 26 pounds.

A roentgenogram showed an abnormal shadow, roughly circular and an inch in diameter immediately above the posterior clinoid process, more than half of it to the left of the median line. The shadow had the density of bone.

On ophthalmologic examination, bilateral partial secondary atrophy was noted.

Pre-operative diagnosis: pharyngeal duct cyst.

Operation was done December 19, 1925. The first stage of a right transfrontal craniotomy was performed, under ether. The wound was closed without drainage. December 24, 1925, second stage, transfrontal craniotomy. The flap was reflected and the suprasellar region readily exposed. At once the wall of the cyst appeared with its bluish discoloration behind the chiasm; it filled the entire space behind the optic tracts and chiasm. The wall of the cyst was incised, and the fluid content was evacuated. A tumor mass, partly calcified, still remained, and as much of this as was in contact with the optic tracts and chiasm was removed piecemeal. There was a hard, calcified mass at the base of the tumor, the shadow of which showed in the roentgenogram.

One naturally wonders whether the extreme emaciation one sees in this disease may not owe its origin to the direct effect of the loss of pituitary secretion upon the pancreas and the resulting hypo-pancreatism. Certain it is that with the loss of pancreatic secretion, as sinus drainage from the upper intestinal tract, there is a rapid and alarming emaciation.

The metabolic disturbances in the pituitary subject are frequent observations though variable and inconstant. In my own series I have been impressed with the fact that when the metabolic rate is not normal, irrespective of the lesion, the rate is below rather than above normal. But the factor responsible for the disturbance in metabolism is not at first apparent. It has been said that in animals the pituitary reacts to many interventions affecting general metabolism, such as thyroidectomy, castration, adrenalectomy, and pancreatectomy and to combinations of these qualitatively in the same way (Poos).

Innumerable experiments upon the result of pituitary ablation have been recorded with results not altogether in harmony. The conflict is attributed to two factors—one, the uncertainty as to whether every vestige of the gland has been removed in the experiment; the other, the question as to whether at the operation damage may not have been inflicted upon the tuber cinerium to which many symptoms, hitherto attributed to the pituitary, have been ascribed. By many it is said that the removal of the pituitary experimentally results in the development of the Frœhlich syndrome. According to Smith an operation has been perfected by which both lobes may be ablated and an invariable syndrome, he says, follows inhibition of growth in the young, cachexia in the adult, atrophy of the thyroids, adrenal, cortex, and genital system. From the clinic we might cite many illustrations of the effect of atrophy or destruction of the pituitary gland in lesions of long standing. Dwarfism, adiposity, sexual apathy, lethargy, in some cases somnolence are the more common expressions.

The differentiation between pituitary lesions of surgical interest and those not presenting indications for operative intervention has for the present been based upon the presence or absence of visual disturbances and in a small number of pituitary headache. Whether in the future resort to surgery will be had to arrest acromegaly or the symptoms of the Frœhlich syndrome is a question.

In a very general way, we may recognize two groups of dyspituitarism: one with and one without evidences of gross lesions. I

have seen a number of cases, especially in adolescents with unmistakable evidence of pituitary dysfunction in which the sella turcica is not enlarged. It is in this group particularly that the question of glandular feeding comes up for consideration.

Whatever the experience of the clinic, experimentally interesting results have been recorded. By some (Schwartzbach and Uhlenhuth), intraperitoneal injections of the anterior lobe into larvæ (urodeles) hastened metamorphosis, probably as a result of thyroid stimulation; by another (Chamberlain), the injections of anterior lobe extracts into rabbits caused definite histological changes in the liver; a number have found feeding of the anterior lobe had a stimulating effect upon growth. For some reason the effect upon invertebrates differs from that of the vertebrate (Thompson).

In the human a number of observations have been made: in one a favorable result was reported in a case of hypopituitarism (Morris and Weiss); in another increase in the specific dynamic response to foods following the administration of the anterior lobe (Kestner et al). One observer failed in a normal subject to influence basal metabolism or the respiratory quotient after oral administration of anterior lobe (Missal and Johnston).

Other observers record in children with infantilism and defective growth considerable improvement from glandular therapy (Gardiner-Hill and Smith). Striking improvement in a case of Addison's disease followed the administration of two grains of the whole gland (Ibotson), and this might be cited as another instance of the stimulating effect of the pituitary upon the adrenals.

There is no question despite the variable results in the laboratory that in certain cases favorable results have been obtained in my clinic from glandular feeding. For illustration I might cite the following case of pituitary dysfunction without evidence of tumor, under observation 4 years with loss of 40 pounds in weight and disappearance of lethargy, following glandular feeding.

G. A., aged 21 years, admitted to the Neurosurgical Service of the University Hospital February 7, 1923. Diagnosis, dyspituitarism.

Before marriage the patient weighed 125 pounds, one year afterward 160 pounds and today 190 pounds. She had been operated upon September 14, 1922, for appendicitis. She had frequent headaches, bitemporal and frontal, was lethargic and mentally sluggish, sleepy most of the time, hyperemotional, worried about and often cried over trivial matters. Except for the adiposity the physical examination was entirely negative. The sella turcica was of normal dimensions, blood pressure 105/70, fields normal, serology negative, blood and urine analyses normal, basal metabolism minus 15.

From 1924 to 1927, she received daily, with certain remissions, 6 grains of pituitary extract and 1½ grains of thyroid extract. When the treatment began she weighed 191 pounds and at the conclusion 150¼ pounds, a loss of approximately 40 pounds. In addition the lethargy had disappeared, and there had been a return of energy and ambition. The hyperemotionalism and irritability disappeared.

A dramatic example of glandular feeding in a case hitherto reported (31) might be cited. The patient, a young man with a pharyngeal pouch cyst was transferred from a state of somnolence to an alert subject; from a bedridden to an active state. At other times I have seen a marked rise in the metabolic rate from a combination of pituitary and thyroid feeding.

To avoid misunderstanding it should be said that in all these cases the administration of pituitary extract was always combined with thyroid extract. Some years ago I found the addition of thyroid extract seemed to fortify the action of the pituitary extract. Whatever the effect of glandular feeding in selected cases I found, many years ago, as one might well expect, that glandular extracts inevitably failed to reduce the size of the lesion.

So far as I know no attempt has been made in the human to treat dyspituitarism by glandular implantations. In the laboratory, certain effects have been observed; regeneration of the atrophied thyroid in certain species (Allen); a specific and highly favorable action on the growth of the ovary (Zondek and Aschheim); direct action upon the gonads (Smith and Engle). Evans and Simpson (6) found that anterior hypophyseal implants produced ovaries 6 times the weight of the ovaries in animals receiving the same implantation with normal adult female hypophyses. Analogous results were obtained in the male and it is the germ cell component of

the testes rather than the interstitial tissue to which the anterior hypophysis is directly related. These experiments would indicate a storage of the sex hormone in the anterior hypophysis after castration.

To apply the implantation method of the laboratory to the treatment of dyspituitarism in the human is impracticable since to obtain positive results implants must be made daily. The variable results that have been obtained in the past with glandular feeding were due in part to the lack of standardization in the products on the market and until a standardized reliable extract is available the results of glandular feeding will not reach their maximum efficiency.

From what has been said it is apparent that glandular feeding or implantation is inappropriate in those cases in which operative interference is indicated for the relief of pressure; that the use of glandular extracts has been effective in combating the effect of hypopituitarism not only in the presence of gross lesions of the pituitary body but in the presence of pituitary dysfunction without evidence of gross lesions no one can now dispute.

There is, I believe, a field of usefulness for radiation, limited though it may be. I am well aware that there may be contradictory evidence as in the reports from the laboratory of Poljaschuk. In studying the effects of pituitary deficiency upon the genital system radiation of the pituitary body has been tried as a substitute for its operative removal. The observer was unable by irradiation of the pituitary to cause any regressive changes in the genital system and as a result drew the conclusion, to me difficult of maintenance, that there was no specific relationship between the pituitary and genital system.

Whatever weight one may attach to this laboratory observation, there is incontrovertible evidence from my clinic, as from others, that radiation does have a beneficent effect in certain selected cases. I say in selected cases because obviously radiation should not be expected to influence lesions essentially cystic. Hence it is not indicated when we are dealing with pharyngeal duct lesions, so frequently largely cystic. But there remains the larger group of primary pituitary adenomata. Here with perfect propriety one may approve radiation under certain restrictions. It has been my practice to recommend treatment by radiation whenever visual disturbances are not too far advanced. The presence of a bitemporal hemianopsia, the degree of field distortion need not be the criterion. One may have a complete bitemporal hemianopsia from pressure alone without as yet permanent damage to the optic nerve. With marked loss of visual acuity and signs of well advanced optic atrophy, the time for radiation has passed. Many of our patients when they apply for treatment are already blind in one eye and to save vision in the other one should not defer operation.

As a matter of fact, we have but three examples to present from our own series with positive results from irradiation. Without citing these cases in detail, suffice it to say that of these three the results in two were only transitory in effect. Eventually it was necessary to resort to operation to conserve vision. In but one have the effects of X-ray treatment been permanent, if by permanent one may be content with a period of 5 years of quiescence. The treatment in this case was begun in February, 1926, and at the present writing there are no signs of progression.

There are so many exact methods of establishing a diagnosis in primary pituitary lesions that this question may be passed by. I might refer only to the information that may be derived from the encephalogram, concerning which I have not seen reference elsewhere. For example, in a patient with recurrence after operation in another clinic an encephalogram revealed the following: obliteration of the cisterna chiasmatis, displacement upward of the third ventricle, encroachment on the anterior horns of the ventricles without displacement of the ventricular system laterally. These findings could all be ascribed to a lesion of the pituitary body and one of considerable dimensions, evidently well beyond the limitations of the sella turcica.

There are then but three methods of dealing with the pituitary lesions: glandular feeding, radiation, and operative intervention. The indications for surgical intervention are well defined; progressive loss of vision in most

cases; in a few, intolerable pituitary headache. What should be the method of approach? One must choose between the transsphenoidal route, popularized by Hirsch of Vienna, and the transfrontal route. With me the pendulum has swung back and forth. My initial experiences were with the transfrontal route; when Hirsch described his transsphenoidal route I used this method exclusively for several years with considerable satisfaction and a mortality of 3.4 per cent. From many points of view the operation has much in its favor, but familiar with the restricted opportunities for dealing with the lesion, one cannot but be impressed with its limitations. At most one can by the transsphenoidal route incise the capsule with a crucial incision and evacuate the contents. Recurrences are therefore inevitable and the measure of relief may be disappointing for reasons easily appreciated. If as in many cases the capsule of the lesion is firm and resisting after evacuation of the contents the capsule will not collapse and pressure on the overlying chiasm and optic nerves persists. It was chiefly for these several reasons that I returned to the transfrontal method.

For various reasons the operation for exposure of the pituitary tumor presents problems differing from those of the conventional craniotomy for brain tumors in general. In the first place one must plan the operation from the cosmetic viewpoint with the least disfigurement as its objective. With this in mind the customary osteoplastic flap is not employed, but in its place I now fashion the scalp flap and bone flap separately. The scalp flap is reflected forward, the bone flap with temporal muscle attached, temporalward. This technique, from the cosmetic point of view, gives the same degree of exposure as by the original transfrontal osteoplastic method.

There are very definite and distinct indications for these several methods of treatment; glandular feeding for pituitary dysfunction, without pressure phenomena; radiation for primary pituitary lesions, particularly adenomata, with evidence of early pressure signs but without signs of advanced optic atrophy; and finally operative intervention when vision is threatened or headache intolerable. The operative risk, now 5 per cent, will I believe in time be reduced materially and the measure of relief in so far as concerns vision will depend altogether and entirely upon the presence and the degree of optic atrophy. Field distortions can be completely abolished and vision wholly restored, if the operation be not delayed as is now so often the case, until atrophy of the optic nerves, one or both, is established. The transfrontal procedure, as I have described it, is now accepted and approved and may be resorted to with reasonable assurance of success whenever the operation is not untimely.

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THE PATHOGENESIS OF ACUTE DILATATION OF THE STOMACH[1]

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THE purpose of this paper is to call attention to a new interpretation of the etiology and pathogenesis of acute postoperative dilatation of the stomach made possible by some recent studies on the physiology of gastric and pancreatic secretion. The outstanding features of the disorder in question are the sudden and often excessive enlargement of the stomach, the regurgitation of large amounts of fluid, the progressive dehydration with suppression of urinary secretion, the occasional symptoms of tetany, and finally collapse and death if adequate treatment is not instituted. The condition is quite probably of frequent occurrence but is unrecognized except in extreme cases. It is likely that every abdominal operation with extensive stimulation of visceral afferent nerves is followed by varying degrees of gastric relaxation, but no untoward symptoms appear and it is unnoticed. It is significant that those surgeons who are interested in this problem find many of these cases in their practice. Most of the reported cases have followed operations under general anæsthesia and it is probable that this postoperative group comprises from 60 to 70 per cent of all cases (Borchgrevinck, 1913; Doolin, 1918). However, the disease has been reported as developing during the course of, or convalescence from, severe and wasting diseases (Herrick, 1906), following childbirth, after falls and injuries, following the removal of body casts, catheterization of the ureters, blows to the abdomen, after errors in diet associated with sudden overloading of the stomach, and in persons with spinal deformities of various kinds (Conner, 1907). It is this wide variety in the apparent exciting factors that has made the analysis of the pathogenesis of the disease so difficult and accounts for the present multiplicity of views.

The striking finding in postmortem examinations is the dilated stomach which often is extreme so that it may fill the entire abdominal cavity and even extend into the pelvis. Except in cases treated by repeated gastric lavage, the contents of the stomach are gas and a thin greenish, greenish-brown, or brownish-black liquid, which is usually odorless and practically neutral in reaction. As would be expected from the great dilatation, the walls of the stomach are exceedingly thin, the mucous membrane pale, but there is no evidence that the distention has interfered with the blood supply to the gastric wall. The greatly distended stomach has been mistaken for a cyst at operation and evacuated (Brown, 1899). If the pathologist has this condition in mind at the autopsy and accordingly makes a special effort to determine the point before the abdominal viscera are disturbed, the duodenum will usually, possibly always, be found compressed to varying degrees at the point where it passes over the spine. Occasionally a reddened line or groove has been found where the stretched mesentery and its vessels have pressed upon the duodenum. In most cases evidence of such marked compression is absent and the examiner's finger can easily overcome the degree of occlusion found. The duodenum proximal to this site is usually distended somewhat but it is not capable of any dilatation comparable to that seen in the stomach (Dragstedt, C. A., 1929). The mucosa of the duodenum may be entirely normal, or hyperæmic and even hæmorrhagic in places. It does not, however, present the usual picture of a strangulated area of jejunum or ileum.

The occurrence of acute gastric dilatation during the course of an abdominal operation and even with the patient in the Trendelenburg position, as reported by Novak (1921), suggests that the mechanism is probably a nervous reflex. This theory is not new. Novak (1921) credits Brinton (1859) with being the first to suggest that a gastric paralysis results from impulses conveyed to it via the extrinsic nerves, and Novak himself believes that this theory more than any other accounts for the immediate etiology of the condition. Recent

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work has greatly clarified our conceptions concerning the mechanism of this reflex inhibition of the alimentary tract. The experiments of Carlson and Luckhardt (1921) demonstrate that it is possible to obtain visceral reflexes from the stimulation of either somatic or visceral sensory nerves. While both motor and inhibitory fibers are present, the predominant effect of the vagus on the tonus of the mammalian cardiac and pyloric sphincters is inhibitory and on the stomach proper is motor. The opposite situation obtains in the effect of the sympathetic fibers from the cœliac plexus. While both motor and inhibitory efferent fibers are likewise present, the predominant effect of the sympathetic fibers on the tonus of the cardiac and pyloric sphincters is motor and on the stomach is inhibitory. Relaxation of the stomach with contraction of the cardia and pylorus has been observed by one of us (L. R. D.) following direct stimulation of the peripheral splanchnic nerves in cats under light ether anæsthesia or reflexly through stimulation of many of the abdominal viscera and of sensory fibers in the sciatic nerve. The nervous pathways involved in these visceral reflexes are indicated in the diagram in Figure 1. Relaxation of the stomach but to a lesser extent has been observed after section of the vagi. Most of the cases of acute dilatation have occurred following laparotomy, and of these, operations on the gall bladder and female generative tract seem more prone than others to cause the trouble. Operations upon the stomach itself rarely give rise to an acute dilatation. The occurrence of acute dilatation following injuries and extra-abdominal operations, such as those on the extremities and face, indicates that profound stimulation of somatic as well as visceral sensory nerves may bring about reflex inhibition of the stomach. The experimental evidence is thus quite adequate to show how the trauma incident to laparotomy, or operative injury to any part of the body, or childbirth, might occasion marked inhibition of the gastric tonus through reflex inhibition of the vagus and stimulation of sympathetic nerves to the stomach. However, the degree of relaxation which is seen in some cases of acute dilatation in man cannot be readily produced in laboratory animals by any amount of sensory stimulation. This may be referable to a species difference or it is possible that some depression in the peripheral gastric motor mechanism is necessary. There is, moreover, direct experimental evidence as well as clinical observation that chloroform or ether anæsthesia depresses the gastric tonus (Payer, 1910), and this no doubt may be an important contributing factor in many cases. Most of the postoperative cases reported have followed general anæsthesia.

The conception of a gastric paralysis in the usual sense through interference with its motor innervation as claimed by Carion and Hallion (1895) and apart from reflex or toxic depression of tonus is probably erroneous. The work of Goltz, Gaskell, Carlson and Luckhardt, Alvarez, and many others indicates that the alimentary tract possesses a peripheral automaticity similar to that of the heart or amphibian lung, and a section of its extrinsic nerves does not produce gastric paralysis any more than section of the vagus or sympathetic branches to the heart results in paralysis of the cardiac musculature. In the course of other work, one of us (L. R. D.) has repeatedly sectioned both vagi and vagi and splanchnics in dogs without producing any evidence of gastro-intestinal paralysis.

In those cases in which acute dilatation of the stomach has come on during the course of an abdominal operation or has been immediately recognized, the content of the stomach is chiefly gas. Analyses of this gas have not been made but it appears quite likely that the major part of it consists of air that has been swallowed during the reflex movements often associated with a beginning anæsthesia (Lee, 1916). A part, doubtless, is gas from the intestines and ether vapor excreted into the stomach. At all events, there is sufficient present to balloon the relaxing stomach often to an amazing degree. Even in severe cases, however, the gas is under greater than atmospheric pressure and it readily escapes when the stomach tube is passed.

Perhaps the question that has given rise to most discussion in considerations of the mechanism of acute dilatation of the stomach is the presence and significance of an associated obstruction to the duodenum. Rokitansky (1863)

was probably the first to suggest that the dilatation of the stomach was due to an obstruction produced by pressure of the superior mesenteric vessels on the transverse portion of the duodenum. This view was endorsed and elaborated by the clinical observations and experiments of Kundrat (1891), Schnitzler (1895), Albrecht (1899), Byron Robinson (1893), Conner (1907), Doolin (1918), and others. As emphasized by Doolin, if the pathologist has this condition in mind at the necropsy, a dilated stomach and a duodenum partly or completely obstructed are the chief anatomical findings. It is assumed that the obstruction to the duodenum by the root of the mesentery can occur only when the intestines sink into the pelvis and thus exert a downward and backward traction on the mesentery. In support of this view are the cases of acute dilatation of the stomach occurring in patients with enteroptosis, emaciation from debilitating diseases such as diabetes, typhoid fever, and tuberculosis, and cases in which loops of ileum have become adherent in Douglas' cul-de-sac from localized peritonitis. This view also offers an attractive explanation for the frequency of acute dilatation in patients with spinal deformities, such as lordosis, where it is obvious that conditions should be optimum for mesenteric obstruction to the duodenum.

All of these studies and observations are of great importance in determining the pathogenesis of the entire symptom complex which attends acute dilatation of the stomach, but they have not clearly demonstrated that a primary occlusion of the transverse duodenum by the superior mesenteric vessels causes the dilatation, although this occlusion may be present and be of the greatest significance in the subsequent course of the disease. It can be easily demonstrated experimentally that a stenosis of the duodenum will result in a gradual dilatation and hypertrophy of the part above the obstruction and the stomach. An acute dilatation of the stomach, however, has never been reported following such a stenosis. As Novak (1921) has pointed out, in the relatively few cases of very high intestinal obstruction that have been reported as a result of various causes, dilatation of the stomach has not been found. Furthermore, the occurrence of acute dilatation of the stomach during the course of an abdominal operation, and even with the patient in the Trendelenburg position, precludes the possibility of duodenal occlusion as playing any rôle in the production. As already stated, it is far more probable that acute dilatation following surgical operations or manipulations involving extensive stimulation of either somatic or visceral sensory nerves is due to reflex inhibition of the stomach through the efferent fibers in the vagi and splanchnics and with a peripheral gastric motor mechanism depressed by anæsthetics, debilitating diseases, or malnutrition.

However, a further analysis of the disease makes it appear quite improbable that the dilatation of the stomach is responsible directly for the protean symptoms that occur. The persistent vomiting, thirst, scanty urine, and collapse, which often make it difficult to distinguish the condition from peritonitis or acute intestinal obstruction, cannot be explained on the basis of reflex or mechanical effects from the stretched and dilated stomach. When such an acute dilatation has occurred on the operating table and has been relieved by the introduction of a stomach tube, the immediate reflex disturbances are slight and recovery is usually prompt.

One of the striking features of the disease is the enormous quantity of fluid that is regurgitated or may be aspirated from the dilated stomach. Indeed, Morris (1883) suggested that an excessive secretion from the stomach mucosa, a gastrorrhœa, was the cause of the gastric dilatation. In one of the early reports, Miller and Humby (1853) described a case of enormously dilated stomach which after death was found to contain "five basinfuls." All recent observers have commented on this excessive fluid. In most cases in which examination was made, the fluid contained little or no free hydrochloric acid, and practically always contained bile (Herrick 1906, Dragstedt and Dragstedt 1922). In the case to be reported here the fluid contained no free acid but the total chloride concentration was 0.35 per cent. It is undoubtedly made up of a mixture of the digestive secre-

tions entering the upper part of the alimentary tract. Riegel (1886), Honigmann (1887), and others have demonstrated that free hydrochloric acid is usually absent in the gastric content of patients with stenosis below the ampulla of Vater, even in non-malignant obstructions. This they attributed to the free reflex of the alkaline juices from the duodenum into the stomach. While most writers have agreed that the fluid is a composite of gastric and pancreatic juice, bile, and the secretion of the duodenal mucosa, practically all have felt that the enormous quantity present was far in excess of the normal volume secreted and have postulated various causes for the hypersecretion. It has been exceedingly difficult to obtain accurate information regarding the total volume of the various digestive secretions poured out in 24 hours under normal conditions. Especially is this true for man, and most estimates have been based upon the results obtained from animal experiments. Rowntree (1922) has constructed the following table showing the volume of digestive juices secreted by a man of average size in 24 hours.

Secretions	Amount per 24 hours c. cm.	Authority
Saliva	1500	Bidder and Schmidt
Gastric juice	2000–3000	Bidder and Schmidt
Bile	300–500	Pfaff and Balch
Pancreatic juice	500–800	Wohlgemuth
Succus entericus	3000	Pregl

In the experiments to be described in detail later it was found that a dog weighing 16 to 20 kilograms would secrete from 1,500 to 2,700 cubic centimeters of gastric juice and from 1,000 to 1,500 cubic centimeters of pancreatic juice in 24 hours. While in both cases the types of fistulæ used probably yielded more nearly the normal volume of the respective secretions than any devised before, nevertheless it is probable that low, rather than high, figures were obtained. Some of the factors known to play a rôle in secretion were unavoidably interfered with in the operative procedures. From these data obtained on the dog it would seem that the estimate given in the table for the 24 hour secretion of gastric and pancreatic juice in man is probably low, and that for gastric juice 3,000 to 4,000 cubic centimeters and pancreatic juice 1,500 to 3,000 cubic centimeters are the more likely volumes. It is thus clear that under the normal conditions of stimulation an exceedingly large volume of fluid passes into the upper part of the alimentary tract.

The experiments of Dragstedt and Dragstedt (1921) suggest that under conditions similar to those existing in acute dilatation of the stomach, there occurs an absorption of toxic substances from the duodenum which have a pronounced secretogogue action. The duodenal obstruction secondary to the gastric dilatation, as indicated below, results in the development of an increased tension in the obstructed duodenum. This increased intravisceral pressure permits the absorption of toxic materials which are otherwise excluded by the selective absorbing function of the intestinal mucosa. These toxic substances have been found to cause a pronounced stimulation of gastric, pancreatic, and duodenal secretion and accordingly this factor may play a rôle in increasing the outflow of digestive fluids in all conditions accompanied by obstruction in the intestines.

As has been suggested, the functional and anatomical conditions present in acute dilatation of the stomach are such as to prevent the gastric and pancreatic juice and bile from passing into the lower intestine, and they accordingly accumulate in the dilated stomach. The evidence suggests a primary gastric dilatation, reflex in origin, either during the course of an extensive operation or immediately afterward. There occurs then a secondary mechanical occlusion of the inferior horizontal portion of the duodenum, either by the direct pressure of the dilated stomach on the duodenum in its passage over the spine or by a secondary arteriomesenteric compression brought about by the downward pressure of the dilated stomach which forces the small intestines into the pelvis. The diagrams in Figures 2, 3, and 4 illustrate the mechanism of this secondary duodenal occlusion.

That this secondary occlusion of the duodenum actually results from the dilatation of the stomach was conclusively demonstrated by a case recently coming under our observation. The patient, a very robust adult male, received a severe blow to the abdomen which

severed the attachment of the root of the mesentery to a large portion of the small intestine. The patient was immediately operated upon by Dr. W. T. Harsha, of Chicago, who resected about 12 feet of the lower jejunum and upper ileum bringing the jejunum to the abdominal wall as a fistula. The patient thus had a functioning alimentary tract consisting of only the stomach, duodenum, and about 6 feet of jejunum. For the first 48 hours there was a profuse drainage of fluid from the jejunostomy opening. This suddenly ceased on the third day, and examination revealed a dilated stomach containing about 1,400 cubic centimeters of characteristic fluid. Aspiration of this fluid greatly relieved the patient, and shortly thereafter the drainage from the jejunostomy again became profuse. The accumulating fluid in the dilating stomach had evidently produced a secondary obstruction to the lower duodenum and prevented the escape of pancreatic and duodenal secretions into the jejunum. The withdrawal of the material in the stomach apparently relieved the duodenal obstruction promptly and permitted the escape of digestive secretions from the jejunostomy.

Halpert (1923) has pointed out that the obstruction is produced by a fold of mesentery belonging to the part of the small intestine which is displaced into the pelvis rather than by the vessels, and accordingly the term mesenteric obstruction to the duodenum is the more accurate. Irrespective of whether the occlusion to the duodenum be due to the direct pressure of the stomach with its large amount of fluid or to this mesenteric compression, it is obvious that the degree of obstruction cannot be very great. This is confirmed by postmortem observations, in which it is usually found that the obstruction can be easily overcome by the examiner's finger, a fact which has led many to question the importance of the duodenal obstruction in the pathogenesis. However, in the presence of the profound reflex inhibition of the motor function of the stomach, and possibly also of the duodenum, and the overdistention produced by gas and accumulating secretions, even a slight obstruction is of the greatest importance. The atonic stomach and duodenum are then unable to propel their secretions into the lower intestine.

Under normal conditions, of course, the gastric and pancreatic juices poured into the upper part of the alimentary tract are more or less completely reabsorbed in the intestine lower down. Water and inorganic salts, the principal constituents of these secretions, are not appreciably absorbed in the stomach, duodenum, or even upper jejunum. A given quantity of water or salt solution placed in an isolated portion of the upper bowel may be recovered quantitatively several hours later. In the lower jejunum, ileum, and colon, however, the absorption of water and certain inorganic salts may be readily demonstrated by this method. It is clear then that for reabsorption, the gastric and pancreatic juices must be carried by the motor activities of the intestine into the ileum and colon. Interference with this transport must result in the loss of the various constituents of these secretions to the body either through vomiting or accumulation in the lumen of the nonabsorbing portions of the tract. The conception that harm might result from the failure of reabsorption of gastric and pancreatic juices has come about largely through experimental work on the pathogenesis of high intestinal obstruction. The loss of gastric juice has been offered as a very attractive explanation for the hypochloræmia, alkalosis, and dehydration that accompany obstruction at the pylorus (MacCallum and associates, 1920; Gamble and Ross, 1925; and others). A more or less crucial experiment demonstrating the fatal effect of the uncomplicated total loss of gastric juice in the experimental animal has been reported in some detail by the present authors (Dragstedt and Ellis, 1929 and 1930). In this work the continuous total loss of gastric secretion under conditions otherwise as nearly normal as possible and in which obstruction in any part of the alimentary tract was not present, was secured by the following operative procedure. Under ether anæsthesia the vagus nerves in the dog were carefully separated from the lower end of the œsophagus below the diaphragm. The œsophagus was then sectioned at the cardia, and the cardiac end of the stomach infolded and closed. The

duodenum was cut across just distal to the pylorus and an end-to-end anastomosis was made between the œsophagus and the duodenum. An external fistula was made of the pyloric end of the isolated stomach for the escape and collection of gastric juice. After such an operation (see Figs. 5 and 6) it is clear that all of the gastric secretion will be permanently drained away but there is present no element of obstruction. Food after being masticated and ensalivated passes directly from the œsophagus into the upper end of the duodenum. It was soon found that, although the animals were given adequate food and water, they became rapidly weak and depressed, lost from one-third to one-half of their body weight, and died in from 5 to 8 days. Accompanying the symptoms were found characteristic changes in the chemistry of the blood. There was a profound fall in the concentration of chloride, an increase in the carbon-dioxide combining power of the plasma, a shift in the hydrogen-ion concentration toward the alkaline side, and a late increase in non-protein and urea nitrogen. The changes in the blood chemistry were roughly proportionate to the severity of the symptoms, and both were without question due to the removal or loss of gastric juice. The important elements lost in the gastric juice are contained in physiological salt solution since by the administration of adequate amounts intravenously the changes in the blood chemistry could be prevented and life indefinitely prolonged. The inefficacy of water alone indicates that it is the ions sodium and chlorine that are of supreme importance.

Of the remaining digestive juices, bile, duodenal secretion, and pancreatic juice, the evidence is now clear that pancreatic juice at least must pass down into the absorbing region of the intestine and there be returned to the blood for life to continue. The innocuous effect of the total loss of duodenal juice was demonstrated by the author and associates several years ago (Dragstedt, Dragstedt, McClintock, and Chase, 1918). That the total escape of bile does not produce acute symptoms has been observed in the many cases of total biliary fistula in the clinic. While some of the earlier physiologists had observed certain deleterious symptoms following the production of an abdominal fistula of the major pancreatic duct of dogs, after the method of Pavlov, Elman and McCaughan (1927) were the first clearly to demonstrate that the continuous loss of the major portion of the pancreatic secretion uniformly caused death in a relatively short time. In a series of experiments, designed to determine this point and undertaken shortly before this paper of Elman and McCaughan appeared, the author and his associates (Dragstedt, Ellis, and Montgomery, 1929) secured data on the effect of the total loss of pancreatic juice by a new method which in large part substantiates and extends the conclusions of these investigators. The details of these experiments will be published elsewhere. It was early recognized that pancreatic fistulæ made after the Pavlov method, by implantation of the major pancreatic duct of dogs into the abdominal wall, did not yield by any means the total secretion of the pancreas. In most cases only from 100 to 150 cubic centimeters of pancreatic secretion could be obtained in 24 hours. It seems probable that the suggestion of Elman and McCaughan that this is due to an ascending infection of the pancreas is probably correct, and it accounts for the failure of earlier observers to obtain a fatal result from experimental pancreatic fistulæ. In our experiments, the duodenum was cut across at the pylorus and again about 8 centimeters lower down, just below the entrance of the lower pancreatic duct. The pyloric antrum was resected and the lower duodenum anastomosed to the open end of the stomach by end-to-side suture. The common bile duct was sectioned near its entrance into the duodenum and implanted into the stomach. The upper section of duodenum containing the entrance of the pancreatic ducts was converted into a closed sac by inversion and closure of both ends. An external fistula of this duodenal-pancreatic sac (Fig. 7) was then established by means of a gold plated cannula similar to that used in the stomach. Pancreatic juice was collected in rubber bags attached to the cannula. The animals recovered promptly from this rather extensive operation, but thereafter lost weight steadily and progressively and became gradually more

weak and depressed. Death occurred within 5 or 6 days. The blood chemistry exhibited changes in some respects opposite to that following the loss of the acid gastric juice. There was a decrease in the concentration of fixed base, to a less extent a decrease in chloride, a marked decrease in the carbon dioxide combining power of the plasma, and a shift in the hydrogen-ion concentration toward the acid side. The extreme loss in body weight was due almost entirely to a loss of water from the tissue spaces, the blood volume remaining normal even in the terminal stages. That death was due to the continuous removal of pancreatic juice is indicated by the fact that the administration of this juice by mouth prolongs life and corrects the altered blood chemistry. Again the fact that by the daily administration of from 2,000 to 3,000 cubic centimeters of physiological salt solution by intravenous injection, life may also be prolonged and the altered blood chemistry in part corrected, shows that it is the elements, sodium and chlorine, in pancreatic juice whose continued removal is fatal. It is thus very evident that the property of the gastric and pancreatic glands whereby they can remove these inorganic elements, sodium and chlorine, from the blood plasma until death is produced makes it necessary that their secretions pass into the absorbing portions of the intestine and there be returned to the blood.

The conclusion seems inescapable that it is this failure of reabsorption of gastric and pancreatic juice that is the major pathogenic factor in acute dilatation of the stomach. The clinical evidence has amply testified to the extreme atony of the stomach and often also of the upper duodenum. It is probable that in many cases this atony alone has led to the failure of reabsorption of the digestive juices since they were not propelled into the lower absorbing intestine. We can thus account for the lethal outcome of cases in which the pathologist has been unable to demonstrate any secondary occlusion to the duodenum. However, when this secondary occlusion is found to be present, even though it be of very slight extent, it may interpose a successful barrier to the feeble peristalsis in the proximal duodenum.

The occasional symptoms of tetany observed in patients with acute dilatation of the stomach may well be referable to the alteration in the chemistry of the blood due to this failure of reabsorption of the excreted digestive juices. An extensive alkalosis exists when there is a predominant loss of acid gastric juice. Tetany uniformly accompanies the severe alkalosis produced by forced breathing. We have been greatly surprised at not finding it in the dog in which an extreme alkalosis was produced by the withdrawal of fixed acid by the draining gastric fistula. It may be that the dog is less susceptible to tetany than man or that some other factor is operative. In this connection it should be observed that in the severe alkalosis produced by hyperpnœa and in which tetany occurs, there is also a profound reduction in carbon dioxide content and in carbon dioxide tension in the blood, whereas in the severe alkalosis following the loss of gastric juice the hydrogen-ion concentration of the plasma may be equally low, but the carbon dioxide content and carbon dioxide tension are far greater than normal. It is possible that a combination of hyperpnœa and loss of fixed acid may produce the alteration in blood chemistry necessary for tetany. This point is being further investigated.

The following case of acute postoperative dilatation of the stomach is significant in that the patient developed the same hypochloræmia and other changes in the blood chemistry which occur in the experimental animal following the simple uncomplicated loss of gastric and pancreatic juice.

The patient, a female of 70 years, was brought to the hospital with a strangulated femoral hernia which had been present for 48 hours. The history and physical findings are unimportant for the purpose of this paper, except for the examination of the blood chemistry. The chloride was reduced to 196 milligrams, the carbon dioxide capacity was 60 cubic centimeters, the urea nitrogen 14 milligrams, and the non-protein nitrogen 31 milligrams. There had been no vomiting. A blood transfusion (500 cubic centimeters citrated blood) was given and a section of gangrenous ileum, imprisoned in the hernial sac, resected. Three thousand cubic centimeters of Ringer's solution was given by vein daily for the next 5 days, but the patient gradually became weaker and changes in the blood chemistry more marked. On the sixth day after operation, the blood chloride had decreased to 180 milligrams, the carbon dioxide

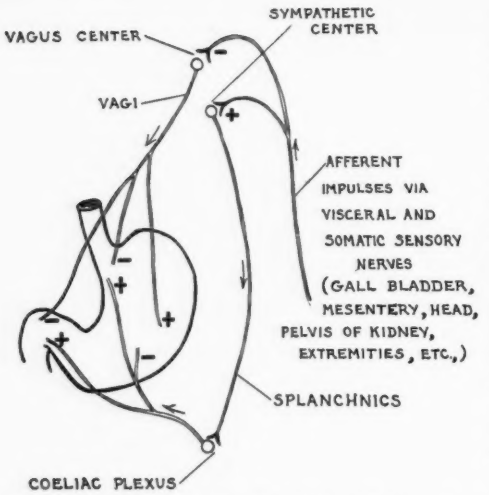
SYMPATHETIC CENTER
VAGUS CENTER
VAGI
AFFERENT IMPULSES VIA VISCERAL AND SOMATIC SENSORY NERVES (GALL BLADDER, MESENTERY, HEAD, PELVIS OF KIDNEY, EXTREMITIES, ETC.,)
SPLANCHNICS
COELIAC PLEXUS

Fig. 1. Diagram illustrating the pathway of nervous impulses resulting in reflex gastric dilatation from the stimulation of visceral or somatic sensory nerves. There are, of course, intercalated neurones connecting the sensory and motor nerves here shown. Reflex stimulation of the sympathetic center is accompanied by a simultaneous inhibition of the antagonist or vagus center, an example of the so called reciprocal innervation.

capacity of the plasma had increased to 86 cubic centimeters, while the non-protein and urea nitrogen were 46 and 32 milligrams respectively. It was concluded at this time that the patient had a generalized peritonitis resulting from contamination at the time of resection of the gangrenous intestine. Vomiting of small amounts of fluid daily had been an inconspicuous feature but on the ninth day after operation 60 cubic centimeters of brownish fluid were regurgitated and saved for chemical analysis. It contained bile and blood, no free acid, and a total chloride concentration of 0.35 per cent. Attempts to aspirate the stomach were given up because of auricular fibrillation and extreme exhaustion. The daily intravenous injection of Ringer's solution was continued, but in spite of this the blood chloride continued to decrease and on the tenth day reached 156 milligrams. Death occurred on the twelfth day after operation. At autopsy the striking finding was the greatly dilated stomach, filling almost the entire abdominal cavity and extending into the pelvis. The illustration shows the relations before the abdominal viscera were disturbed. The dilated stomach contained about 3 liters of thin brown fluid. Unfortunately, this was lost, but it is probable that its composition was similar to the vomitus secured on the ninth day. There was no evidence of peritonitis. A carcinoma of the neck of the gall bladder, extending to and producing stenosis of the pylorus, was found. The pyloric opening was approximately 2 millimeters in diameter. The duodenum proximal to the point where the fold of mesentery and vessels passes anteriorly was slightly dilated and filled with brownish fluid similar to that in the stomach. No definite obstruction at this point was noted by the pathologist.

While there are several complicating factors in this case, the acute dilatation of the stomach here presents in its elements the same problems met with in other types. It seems probable that the sequence of events has been somewhat as follows. The stenosis of the pylorus was so gradual in development that the increasing motility and hypertrophy of the stomach succeeded in forcing the gastric content into the lower intestine. However, the development of the obstructed strangulated loop of ileum in the femoral hernia and perhaps of greater significance the operative trauma incident to the resection of the gangrenous intestine, resulted in such a profound reflex inhibition of the gastric motor mechanism that the feeble peristalsis could no longer force gastric juice through the narrow pylorus. It consequently accumulated in the dilating stomach. With the patient lying on her back in bed, it is quite probable that this weight of the filled stomach pressing upon the inferior horizontal portion of the duodenum produced some duodenal obstruction. Likewise, conditions were favorable for the development of a certain degree of secondary mesenteric obstruction to the duodenum inasmuch as the small intestines were forced into the pelvis by the dilated stomach and it is probable that the fold of mesentery belonging to the displaced intestine then exerted a definite compression although this was not evident at autopsy. The presence of fluid in the proximal duodenum similar to that in the stomach and its absence in the distal duodenum suggests such obstruction. Gastric juice and later pancreatic juice and bile accumulated in the non-absorbing upper duodenum and stomach and were thus effectually lost to the body. The development of the marked hypochloræmia in this patient is added evidence that the failure of reabsorption of digestive juices here played a large rôle. Had this been the sole factor in this case, it is probable that the intravenous salt solution would have continued to keep the patient alive. However, the ad-

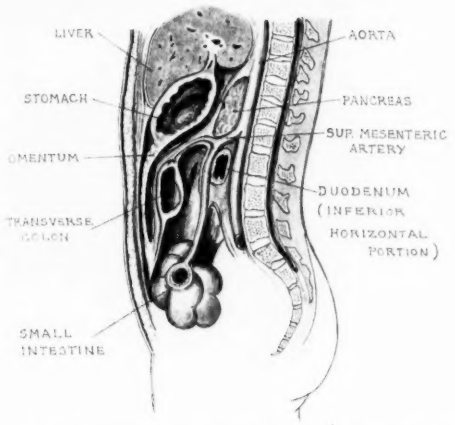

Fig. 2. Diagram illustrating the normal relations of the stomach, the mesenteric vessels and fold, the inferior horizontal portion of the duodenum, and the spine.

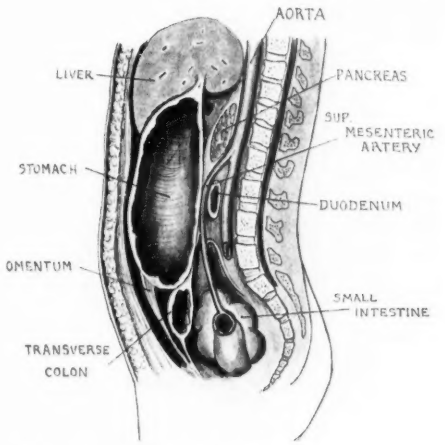

Fig. 3. Diagram illustrating how dilatation of the stomach forces the small intestines into the pelvis, produces a downward and backward traction on the mesentery, and a secondary duodenal compression.

vanced age, the myocardial damage, and the systemic intoxication from the carcinoma made such treatment ineffectual.

SUMMARY

Evidence has been presented which offers a new interpretation of the cause of death in acute dilatation of the stomach. The dilatation is held to be due to reflex inhibition of the peripheral gastric motor mechanism through efferent impulses reaching the stomach by way of the vagi and splanchnics. Experimental evidence is adequate to show that the stimulation of either visceral or somatic sensory nerves may produce such reflex gastric inhibition. The dilatation of the atonic stomach is produced by swallowed air and the accu-

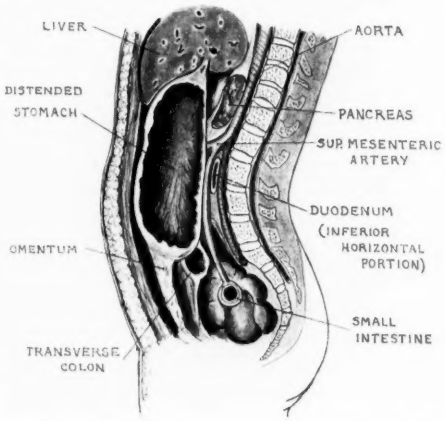

Fig. 4. Diagram illustrating the greater liability of persons with lumbar lordosis to duodenal occlusion as a result of extreme gastric dilatation.

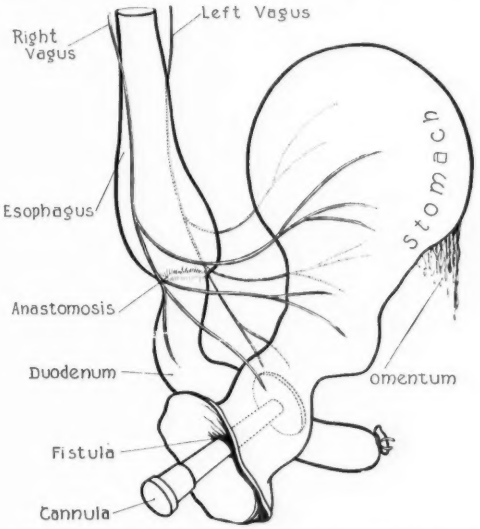

Fig. 5. Diagram illustrating the fistula of the isolated entire stomach with innervation intact.

Fig. 6. Drawing made at autopsy showing the isolated stomach and fistula.

mulating secretions of the stomach and duodenum. The fluid is made up of gastric and pancreatic juice, bile, and the secretions of the upper duodenal mucosa. From some recent observations on the normal volume of the digestive secretions in the dog, which indicate that previous estimates have been far too low, even the large amounts found in acute dilatation of the stomach do not seem excessive or the result of abnormal secretion. The cause of death is the failure of reabsorption of gastric and pancreatic juices, and more particularly of the inorganic elements, sodium and chlorine, excreted in these fluids. The failure of reabsorption in turn depends upon the inability of the atonic stomach and duodenum to propel these secretions into the lower intestine where their absorption can take place. The gastric and duodenal mucosa does not absorb these digestive juices. In certain cases a secondary mesenteric obstruction to the inferior horizontal portion of the duodenum occurs and provides a further obstacle to the passage of the secretions into the lower bowel. In the clinical case reported the patient developed an hypochloræmia alkalosis and dehydration exactly as occurs in the experimental animal when the gastric juice secreted is not allowed to be again absorbed. It is probable that the occasional symptom-

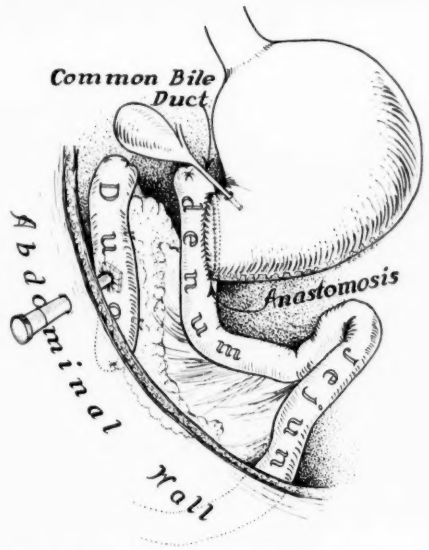

Fig. 7. Diagram illustrating the fistula of the pancreatic duodenal sac permitting the total escape of pancreatic juice.

Fig. 8. Photograph taken at autopsy illustrating acute postoperative dilatation of the stomach.

of tetany observed in cases of acute dilatation of the stomach are due to the alterations in the blood chemistry as a result of the failure of reabsorption of gastric juice.

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THE SO CALLED FEMALE PROSTATE AND CONCRETION FORMATION IN THE FEMALE URETHRA

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IN the gross anatomical examination of the female urethra, one finds only a few varieties of pathological conditions; for example, intensive passive congestion, fibrinous inflammation, varicosity, carunculæ, leucoplakia, cysts (Wesson), and diverticula (Peacock). Especially in the posterior portion of the female urethra of elderly women, one very occasionally finds a muscular thickening in the wall, with which are associated solitary or multiple thickenings of the mucous membrane. These are hard, black excrescences which look like nodules. They are designated as concretions. Very often during postmortem, one sees such changes in the prostatic portion of the male urethra, especially in the muscularis mucosæ folds at the side of the colliculus seminalis. In the male, these are doubtless prostatic concretions which are partly pressed out from the acinous portions of the excretory ducts by contractions, and seemingly some develop in the ends of the small ducts of the prostate. In the publications of Nagel, Waldeyer, Felix, Kaufmann, Aschoff, and others, the conception of a female prostate has found acceptance in theoretical medicine. According to the gross anatomical similarity between the previously mentioned conditions in the female and male urethra, it is necessary to draw a further comparison from a histological viewpoint and to examine, in this way, to learn whether or not any developmental remains of the prostate or Gaertner's ducts still exist in the female urethra.

At the suggestion of Dozent Dr. Th. Bauer, the director of the institute, I examined two urethras and bladders which were obtained from autopsies in 1926 and 1928 and which had been preserved in the museum. These were labelled with the diagnosis, "concretion formation in the muscularis mucosæ of a female urethra." I also obtained six other specimens of female urethras. The ages varied between 40 and 72 years. The urethras had been preserved in 10 per cent formalin or formalin alcohol (some open and some closed) immediately after they had been removed from the cadaver. Examination was made of a series of specimens taken from the posterior portion of the urethra, cut in cross section and longitudinally.

In the description which follows, the two pathological specimens with concretion formation will be mentioned first.

CASE 1. Notes 815/26. Urethra and trigonum of a woman, aged 58 years. The urethra which is about 4 centimeters long, shows intensive injection of the muscularis mucosæ which is folded longitudinally. At its entrance into the bladder the urethra shows strange, shiny black, irregularly limited formations about the size of a pin point, almost sticking into the muscularis mucosæ. These are surrounded by a wall like thickening. The trigone shows the same formation but only in the immediate surroundings of the so called transitional fold (plica urethro-vesicalis) from the urethra to the bladder. These black concretions can be drawn up out of their muscularis mucosæ pockets with a needle. They are very hard and correspond absolutely to the concretions met with in the male bladder and sticking in the excretory ducts of the prostate. The remainder of the trigonal muscularis mucosæ and of the bladder, show no departure from normal.

Longitudinal sections from the bottom of the bladder to the external urethral orifice were taken for microscopic examination. Commencing with the examination of the trigonal portion, one finds a very wide muscular layer of longitudinal fibrils beneath the delicate transitional epithelium. Below this muscular layer, one sees complex gland structures of acinous and tubular elements which give the impression of prostatic glands. The epithelium shows a palely stained protoplasm and round oval seed-like structures. The lumen is sometimes round and sometimes it is polymorphic, with excavations and puckerings. The contents consist of a homogeneous mass, stained red with eosin. The glands increase in size and extent, the closer they approach the posterior portion of the urethra. Here one is able to follow the tubules ramifying without system in the crossing muscle bundles and passing deep into the muscle bed of the septum urethrovaginale. Both the superficial and deep portions of these complex gland structures have great resemblance to the male prostate and, in a certain way, to

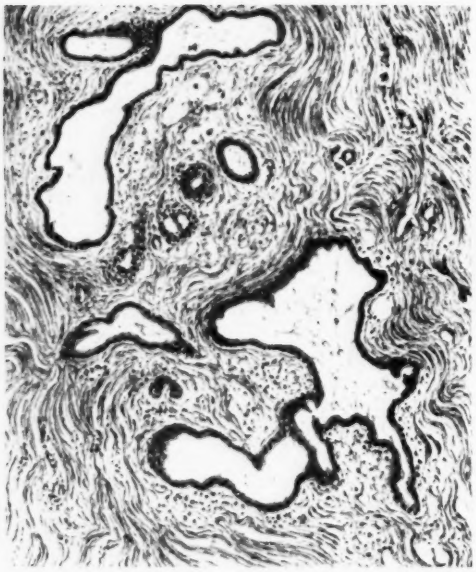

Fig. 1. Case 1. Glands found deep in vesicovaginal septum resembling Cowper's gland.

Cowper's glands, particularly in the peculiarity of the gland contents. In this case we find piled up amylaceous corpuscles in all degrees of development from their origin to the completed concretion. In all stages, mineral deposits are seen in the preformed amylaceous corpuscles. Microscopically, the product has a yellowish brown, or sometimes a greenish, polygonal form with points and sharp corners; and by its increase in size, outgrows the space of its developmental pouch and projects over the surface (Fig. 1).

Case 2. Notes 916/28. The urethra and trigonum of a woman, aged 59 years. The urethra shows very small knots with superficial shallow depressions from which a black foreign body is projecting. This is especially noticeable in the posterior portion of the transitional fold of the bladder. Some of these foreign bodies, by gradually growing out of their beds, may be removed by slight pressure. These formations are absolutely limited to the posterior part of the urethra and the muscularis mucosæ of the trigone is absolutely free. A small cyst about the size of a poppy seed should also be mentioned. It lies in the submucosa 0.5 centimeter from the bladder and can be seen only with difficulty.

With the microscope, many glandular structures may be seen in the longitudinal section of the posterior urethra. Some are placed immediately below the epithelium of the muscularis mucosæ and are called para-urethral glands; others lie deeper in the smooth muscle of the urethrovaginal septum. The tubules ramifying deeper down, have two rows

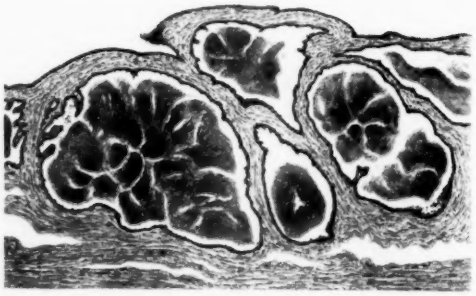

Fig. 2. Subepithelial prostatic ducts with many hard concretions.

of epithelium with a palely staining protoplasm and round, dark colored nuclei. The gland content is homogeneous, staining red with eosin, and of a similar structure to the amylaceous corpuscles. In some of the glands it is chalky or encrusted with minerals. The natural color of these concretions is dark brown when seen macroscopically and greenish gray when seen microscopically. Corresponding to the colliculus seminalis of the male, quite a big cyst covered with transitional epithelium is to be found in the posterior portion, surrounded by a prostatic-like structure of glands. In almost every such acinus, the characteristic piled up formations similar to amylaceous corpuscles, may be seen.

Case 3. Notes 1382/30. Woman of 70 years. The bladder and urethra with small varicosities in the posterior portion were opened longitudinally and cut in cross section. Microscopically, the extremely large, blood filled cavernous space underneath the urethral muscularis mucosæ can be seen to be partly thrombosed. Gland-like structures, apart from the small ones that have developed from Brun's nests and lie in the muscularis mucosæ, cannot be found in this case; nor can they be seen in the urethrovaginal septum. The whole urethra is infiltrated by round cells and presents a picture of senile atrophy.

Case 4. Notes 1664/30. Urethra and bladder of a woman of 55 years, were opened longitudinally. No macroscopic peculiarities were noted. In the posterior portion of the urethra microscopic tubules of the characteristic shape of the prostate and Cowper's glands and situated deeply in the musculature and passing deeply through the urethrovaginal septum, similar to the cases described, are present. In most cases, the covering consists of one or two rows of epithelium. The content of these glands is a homogeneous mass, stained red with eosin, which may be likened to pseudomucin.

Case 5. Notes 2461/30. Urethra and bladder of a woman of 62 years. The specimen was preserved unopened with formalin and cut in parallel longitudinal series. The microscopical sections allow a clear view of the whole length of the urethra. If one concentrates at first on the portion of the external

urethral orifice, one can see Skene's glands ducts as tubules, most of them running parallel to the urethra, winding a little and crinkled, which by their direction and arrangement remind one of the para-urethral ducts of the male urethra. The gland structure around the urethra contains too microcystic widened formations to be identified with prostatic elements by their arrangement and character. In most cases the formations are covered with a two row epithelium which is chiefly of the cubical or low cylindrical type. Moreover, the content of these formations reminds one of the acini of the prostate because here are piled up forms consisting of a homogeneous mass, stained red with eosin, similar to the amylaceous corpuscles. Some of the microcysts also contain large quantities of the same brownish material, apparently originating by the confluence of small similar formations. Scattered in the mass itself, one finds chalk which may be considered as being the origin of prostatic concretions. In approaching the posterior part of the urethra, one recognizes branches of the prostatic gland or Cowper's glands reaching deeply into the urethrovaginal septum, apart from formations in larger quantities, previously described.

CASE 6. Notes 4563/30. Bladder and urethra of a woman of 48 years, were removed intact and filled with formalin. After fixation, longitudinal cuts as far as the neck of the bladder were made throughout the whole length of the urethra. The epithelium at the base of the urethra shows histologically the same character as the transitional epithelium of the bladder, inclining in some places to the formation of papillæ. In addition, one finds three types of glands in this portion: first, those corresponding to the type of Brun's cell nests and which are accordingly developed from epithelial buds by central liquefaction; second, there are solitary glands or cysts covered with some rows of epithelium situated, as a rule, just below the urethral epithelium (periurethral glands); and third, the more acinous in type, with numerous excavations and niches, the ramifications of which reach deeply into the urethrovaginal septum.

Contrary to those previously described, it seems that these acini are embedded in gaps of the twisting smooth muscle bundles, where they remind one very much of the male prostatic gland. The other types are almost circular and are surrounded by a ringed layer of smooth muscle.

CASE 7. Notes 4621/30. Urethra and bladder of a woman of 56 years, were opened and preserved. Series cut in cross section from the bladder neck to the external urethral orifice. Macroscopically, one can see a medium bulging originating in the base of the urethra. Microscopically, the portion belonging to the neck of the bladder and to the trigone respectively, is rich in Brun's cell nests and in small cysts which originate in the nests. By their close relation to the upper epithelial layer, they can hardly be confused with other formations. The posterior portion, which is adjacent to the bladder neck, shows a strange condition. Corresponding to the verumontanum, large cyst formations of the prostatic utriculus are to be found. The cystic cavity that is present here develops by the confluence of the two symmetrical cysts which look as though they had been previously covered, partly by several rows of cubical epithelium and partly by transitional epithelium. The contents consist of a fine threaded and a finely granular mass. Around this utriculus, prostatic glands and ducts are spreading, completely identical to the male colliculus. They are scattered about in the winding of the muscle bundles. Also in the middle portions of the urethra as well as in the anterior portions, formations similar to those described are to be found. A few gland ducts of the type of the prostatic and Cowper's glands respectively, are to be found in the urethrovaginal septum.

Fig. 3. Specimen removed from Case. 1.

CASE 8. Notes 6650/30. Urethra and bladder from a woman of 49 years showed no anatomical peculiarities. The specimen was opened longitudinally and preserved. In the posterior urethral portion, histologically large glandular struetures are to be seen, which are arranged in an acinous collection. They penetrate deeply into the smooth muscle layer. The glands are mostly covered by a two row epithelium and solitary branches pass finally, fairly deep down into the urethrovaginal septum. They present a picture of Cowper's glands and are comparatively poor in secretion.

In consideration of the findings, the first two cases are the most striking because genuine concretions are to be found in the posterior urethra. It can be proved absolutely that these formations have an autochthonous development and that they are not small stones which have passed down the upper

Fig. 4. Case 2. Subepithelial prostatic duct containing concretions.

urethral ducts, because the concretions are sticking in the muscularis mucosæ and can be removed only mechanically.

The question now arises whether the concretions originate in preformed glands, microcysts or cavities, or whether they are perhaps phleboliths of the corpus cavernosum. As the para-urethral glands and ducts, which can be seen by the description already given, contain no concretions or their precursors, and as further reflection leads to the certainty that the small cysts originating in the Brun-Limbeck nests can never show concretion building, one comes to the natural conclusion that only the rudimentary prostatic portions can be considered as being the site of origin of the small stones.

Actually, the glands which have been found in the two cases, correspond morphologically, and also according to their arrangement, to the male prostatic glands.

Fig. 5. Case 2. Specimen removed.

In nearly all the female urethras which have been examined and described here gland-like formations were to be seen. These represent, on one hand, urethral ducts (ductus para-urethrales) according to Skene; and on the other hand, as Felix, Nagel, and Waldeyer have already stated, formations of the type of prostatic glands. The findings mentioned show that in the prostatic glands (so called) which have, up to now, not met with general approval, the presence of the smallest concretions, which are like coarsely ground pepper, could not be proved (Fig. 2). Another proof that the gland-like formation in the urethra is of a prostatic nature is that the concretions may be traced by their deep penetration.

In most of the cases, it could be shown that the small gland complexes, which are sometimes quite close to the vaginal muscularis mucosæ, are almost detached from the general gland structure of the urethrovaginal septum. According to their situation, they correspond to Cowper's glands and it is therefore more likely that a rudiment of Cowper's glands may be seen in this formation. If one looks upon this region from the standpoint of developmental history, one finds, in Corning, the definite statement that the *glandulæ bulbo-urethrales* (Cowperi) are only to be found in 48 millimeter long embryos, and that the prostate corresponds ontogenetically and phylogenetically to a complex of urethral

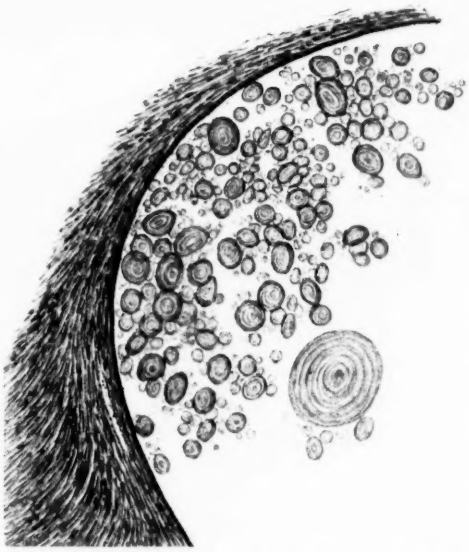

Fig. 6. Amylaceous corpuscles in prostatic acinus. Case 2.

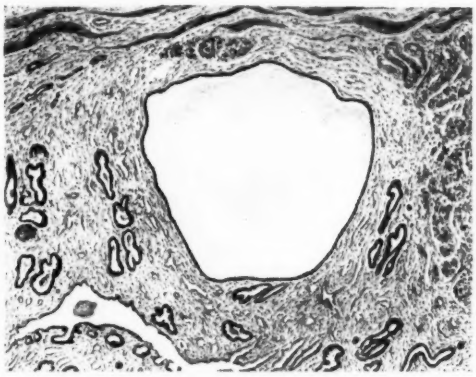

Fig. 7. Cross section of female urethra. Cyst formation corresponding to the verumontanum surrounded by prostatic glands. Case 7.

glands which break through the tunica muscularis. They completely surround the urethral prostatic portion by settling in the gaps of the interwinding muscle bundles. Corning expressly mentions that the urethral prostatic portion corresponds to a part of the female urethra and urogenital sinus. The openings of Wolff's and Mueller's ducts must be considered as the upper border of the urogenital sinus. This makes an area between these two points and the openings of the ureters into the bladder, which is not only the origin of the trigonum, but also provides the internal orifice of the urethra and the upper part of the urethral prostatic portion. In the male fetus, a primitive orifice of the urogenital sinus develops in the perineum, but this closes early. Therefore the female urogenital sinus, i.e., the vaginal vestibule, may be compared with the lower part of the urethral prostatic portion underneath the colliculus seminalis and the pars membranacea of the urethra of the male fetus, whereas the female urethra originates from (1) Mueller's prominence (colliculus seminalis of the male fetus), (2) the part bordered by the internal urethral orifice which corresponds in the male to the upper part of the urethral prostatic portion (Corning). According to Oudemanns, the glandulæ bulbo-urethrales in marsupials occur throughout the whole length of the urogenital canal and in such thick layers that they make a fusiform swelling, which by an error has been taken for the prostate. It is only when glands also occur outside the smooth musculature of the urethra, that we can speak of the prostate in the correct sense of the word. According to Corning, there is, in human beings, a possibility that prostatic tissue develops in the course of the pars membranacea or cavernosa as a case described by Luschka proves. Here on the dorsum penis and the border of the pubic hair, prostate tissue could be found.

Further, it is not uninteresting to mention new experiments made by Lowsley, as a comparison of the cases described to the state of development of the male prostate.

In the third month, the first foundations occur on several parts of the urethral prostatic area. There are five existing groups, from which the one originating in the posterior urethral wall above the opening of the prostatic vesicle, furnishes the middle lobe; the two on both sides of the colliculus furnishing the two lateral lobes. One lobe develops behind the prostatic vesicle as the posterior section and finally a foundation on the anterior urethral wall develops into a rudimentary anterior lobe. As this complex of

questions is very important for the solution of the problem of prostatic hypertrophy, the subcervical glands (Albarran) should be specially mentioned. At the same time as the development of the urogenital sinus, the preprostatic elements, which can be identified as Skene's ducts and para-urethral glands, whose openings into the vaginal vestibule lie on both sides of the external urethral orifice, developed from the posterior wall (Corning).

It can be stated, therefore, that in the fully developed female urethra, two kinds of glandular formations can be found, such as Sachs, in his various publications, has described. These are the peri-urethral and para-urethral glands. The material examined here definitely shows that the unilocular formations, covered with several rows of cylindrical epithelium, can be considered as para-urethral glands, whose origin from the Brun-Limbeck cell nests is an established fact.

It can be seen immediately that the cysts found here are identical with those found in cystitis and pyelitis cystica, the phases of development which are very well known.

Whereas the prostatic elements show peri-urethral arrangement, they are acinous in character and covered with a two row, low cylindrical celled epithelium. The microscopic examination of normal bulbo-urethral glandulæ (Cowperi), which are in elderly men only poorly developed, shows a great similarity to the prostatic glands and the secretion product shows also much resemblance to the prostatic secretion. In the same way that the prostate is in rudimentary relationship with Skene's ducts, so the buds of the peri-urethral glands can be proved to lie also as rudiments in the urethrovaginal septum. In a corresponding series of experiments, these glands may be demonstrated.

CONCLUSIONS

1. The female urethra shows much resemblance to the male urethra, especially in its relationship with accessory glands, genital apparatus, and Cowper's glandulæ bulbo-urethrales.

2. The unilocular cysts and Skene's ducts are to be considered as para-urethral glands.

3. Acinous formations are of prostatic origin, especially when they are embedded in the smooth musculature.

4. Corresponding to the colliculus seminalis, a submucous cyst is to be found in the female urethra surrounded by prostatic glands so that the prostatic utriculus can be seen in rudimentary form.

5. The concretions which are eventually found in the prostatic glands correspond morphologically and in their consistency absolutely to the male prostatic concretions.

6. The physiological and pathological anatomical findings which have been mentioned are of an importance for the application of urology, which should not be underestimated as concretion formation in the urethra muscularis mucosæ may cause severe complications, such as ulcers, phlegmons, or strictures.

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NON-SPECIFIC PERITONEAL IMMUNIZATION[1]

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THIS work represents an experimental study on the production of peritoneal immunity in rabbits by the intraperitoneal injection of inert substances, and a study of the local cellular changes concurrent with such immunity.

Local peritoneal immunity can be induced in animals by repeated intraperitoneal injections of living bacteria, as shown by Goldblatt and Steinberg, and by injections of dead bacteria, as shown by Herrmann. Similar local immunity has been obtained by the use of such non-specific substances as physiologic solution of sodium chloride (14), nuclein (3), gum arabic (7), and various oils (15).

METHOD OF STUDY

The studies are the outgrowth of an attempt to produce rapidly peritoneal immunity after the methods of Besredka for producing cutaneous immunity. They are divided into methods of producing peritoneal immunity with non-specific substances, and observations on the associated cellular changes.

Studies on production of immunity. A strain of hæmolytic streptococcus of moderate virulence was grown in dextrose broth for a period of 10 days. A sterile filtrate was obtained by using a Berkefeld (N) filter. Intraperitoneal injection of this filtrate into rabbits was followed in most instances by death within a few hours. Boiling the filtrate for 30 minutes removed or greatly reduced this toxicity. Animals were given intraperitoneal injections of 20 cubic centimeters of the heated filtrate on alternate days for four doses. Four days later these rabbits, with an equal number of control animals, were given intraperitoneal injections of a lethal dose of a 24 hour live culture of hæmolytic streptococci. Within 2 to 8 days after the injection, all of the control animals died, whereas the inoculated animals remained alive and active.

Similar experiments were then performed, in which sterile dextrose broth and a 10 per cent sterile solution of glucose were used as the immunizing substances. These substances proved equally effective in producing peritoneal immunity against hæmolytic streptococci. Some of the immune rabbits in this group subsequently were inoculated intraperitoneally with a lethal dose of a 24 hour culture of colon bacilli. The control animals were all dead within 12 hours after this inoculation, whereas, in the prepared animals, evidence of ill effects was not seen.

In none of the animals was there evidence of formation of adhesions as a result of irritation from the injected solutions. This is in accord with the work of Cunningham (4), who showed that after 14 daily intraperitoneal injections of 10 per cent solution of glucose, desquamation of the peritoneal mesothelium is not sufficient to permit formation of adhesions.

Studies were next made to determine the minimal time required adequately to immunize rabbits against marked intraperitoneal infection. The immunizing substances were heated streptococcus filtrate, dextrose broth, 10 per cent glucose in physiological solution of sodium chloride, 5 per cent glucose in physiological solution of sodium chloride, and 1 per cent solution of sodium chloride. The animals used for the test may be divided into two main groups. Animals in one group were given intraperitoneal injections of the various solutions twice daily for 2 days, and those in the other group received three injections over a period of 24 hours. In both groups the test inoculation was given either 8 or 16 hours later. Normal control animals of corresponding size were inoculated simultaneously, using the same dosage from the same culture of hæmolytic streptococci. The inoculation used as a test in this series of experiments was of sufficient dosage to kill all of the controls within 24 hours. However, this inoculation reduced the percentage of recoveries among the animals prepared over a period of 2 days

[1]Abridgment of thesis submitted to the faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, 1930.

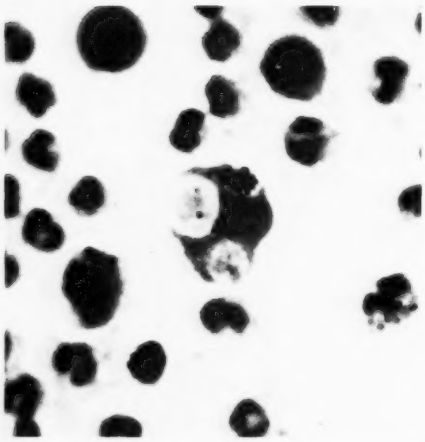

Fig. 1. Phagocytosis of leucocytes and streptococci by macrophages in the peritoneal fluid from an immunized rabbit (Gram stain, ×1000).

to 80 per cent, and among those prepared over a period of 1 day to 54.5 per cent. In a few instances, definite immunity was present 30 hours after the initial immunizing injection, but in 80 per cent of the cases about 64 hours were required for a defense mechanism to develop, of sufficient strength to give protection. Increasing the period of immunization will increase the recoveries to 100 per cent, as shown in the previous experiments (Table I).

Study of cellular changes. Considerable study has been made of the cellular content in peritoneal exudates induced in animals by intraperitoneal injection of various irritants. Durham noted a leucopenic period in the first hour, which was followed by polymorphonuclear leucocytosis. The macrophages, with great phagocytic power, appeared after 15 hours. Von Mikulicz found general as well as local hyperleucocytosis. Buxton and Tracy found the number of macrophages markedly increased 24 hours after inoculation of prepared animals. Witts found the number of polymorphonuclear leucocytes in guinea pigs to reach a peak in 12 hours, and after 24 hours found them to be rapidly replaced by macrophages and lymphocytes. Metalnikov and Toumanoff found that the more guinea pigs are immunized or sensitized, the more

TABLE I.—SUMMARY OF RESULTS ON PERITONEAL IMMUNIZATION

Immunizing substance	Immunization period (3 to 4 injections), days	Interval between last injection and test inoculation, days	Rabbits		
			Injected	Recovered	Died
Heated filtrate of culture of hæmolytic streptococcus	6	2 to 5	4	4	
	2	2/3	2	2	
	1	2/3	2		2
		1/3	4	1	3
Dextrose broth (0.2 per cent)	6	2 to 5	2	2	
	2	2/3	4	4	
	1	2/3	2	2	
		1/3	4	3	1
Glucose (20 per cent) in distilled water	6	2 to 5	3	3	
	2	2/3			
	1	1/3	1	1	
Glucose (10 per cent) in sodium chloride solution (1 per cent)	6	2 to 5			
	2	2/3	1	1	
	1	2/3	2	1	1
		1/3	3	2	1
Glucose (5 per cent) in sodium chloride solution (1 per cent)	6	2 to 5	2	2	
	2	2/3	1		1
	1	2/3			
		1/3			
Sodium chloride solution (1 per cent)	6	2 to 5			
	2	2/3	2	1	1
	1	2/3	2	1	1
		1/3	2	2	
Total of test animals			43	32 (74%)	11 (26%)
Controls			17		17 (100%)

rapid and intensive is the intraperitoneal reaction by the cells to defend the organism. Gay, Clark, and Linton found local pleural immunity against the streptococcus to be dependent on the presence of clasmatocytes in the pleural tissue and exudate. A large number of polymorphonuclear leucocytes alone would not confer immunity. Buxton and Torrey, however, reported on data which suggest that the macrophages cannot effectively dispose of escherichia coli unless there is considerable polymorphonuclear response.

The observations on peritoneal smears are presented to show the relationship which seems to exist between the presence of certain cells, the so called macrophages, and local immunity against the hæmolytic streptococcus. The term "macrophage" is to be used, as Witts uses it, to include cells which may be classified either as tissue clasmatocytes or monocytes of the blood.

Smears were made from the peritoneal fluid obtained at necropsy or by peritoneal punc-

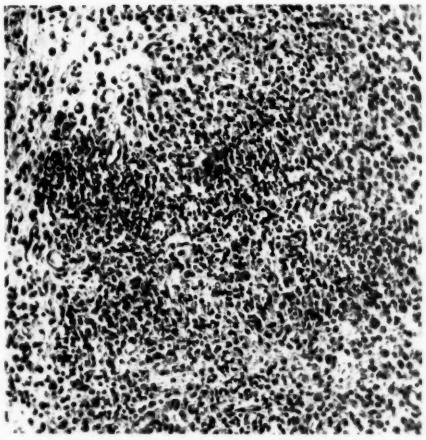

Fig. 2. Infiltration of the omentum of an immunized rabbit with macrophages (hematoxylin and eosin stain ×200).

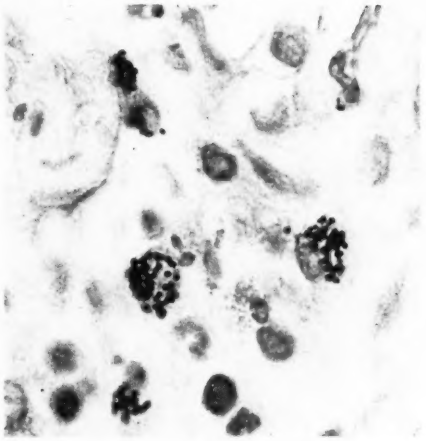

Fig. 3. Macrophages and phagocytosed streptococci within the omentum of an immunized rabbit (Gram stain, ×1000).

ture. The smears were stained by Wright's and by Gram's method.

The results of this study (Table II) show that in those animals which survive the initial assault of the inoculation, there is moderate to marked cellular response in the peritoneal fluid. Phagocytosis, chiefly by the macrophage cells, is a prominent feature; there are few bacteria free in the exudate (Fig. 1). In contrast to this, the smears from animals that succumbed to the inoculation contained few cells, practically no evidence of phagocytosis, and a great number of free streptococci. There was a change in the proportion of the different types of cells in the smears according to the length of time they were taken after the initial preparatory injection and interval after the test inoculation. From the immune animals which were inoculated about 30 hours after the first immunizing injection, the smears taken 24 hours later disclosed a high percentage of polymorphonuclear leucocytes, whereas the smears from the animals which were inoculated 40 hours after the initial injection, with one exception, disclosed a preponderance of macrophages. In those animals killed 2 or more days after inoculation, the number of macrophages rapidly took the ascendancy. The number of cells in the smears reached a peak on the second to third day after inoculation; in smears made on the fourth day the number of cells was greatly reduced and the majority held by the macrophage cells on the second and third days was being reduced by an increasing number of lymphocytes.

Goldschmidt and Schloss found increased bactericidal power of the omentum of animals after a second laparotomy. Portis reported experimental evidence to show that the omentum is a factor in production of antibodies following intraperitoneal injection of the antigen, and stated that the clasmatocytes appeared to be definitely involved in this production. Cunningham (5) stated that the majority of the cells in the peritoneal exudate during inflammation are derived from the clasmatocytes, which occur chiefly in the neighborhood of blood vessels and in the *taches laiteuses* of the omentum. Hamazaki accredits the milk spots of the omentum with the supplying of histocytes to the abdominal cavity.

A comparative study showed a marked contrast both in the gross and the microscopic appearance of the omentums from protected and from non-protected animals. The gross appearance of the omentums from the animals which had been adequately immunized was uniformly characteristic. The loosely folded omentum had a light, flesh color with mucoid

TABLE II.—DATA ON PERITONEAL SMEARS AND SECTIONS FROM OMENTA

Animal	Injections	Immunizing substances	Period of immunization, days	Interval between last injection and test inoculation, days	Result of test inoculation	Interval between test inoculation and taking of specimens, days	Cells in omentum		Peritoneal smears			
							Polymorphonuclears	Macrophages	Cells	Polymorphonuclears, per cent	Macrophages, per cent	Phagocytosis
1	3	1 per cent sodium chloride	1	2/3	Recovery	1	Few	Moderate	Many	40	60	Marked
2	3	10 per cent glucose	1	2/3	Death	1	Many	Few	Few			None
3	3	10 per cent glucose	1	2/3	Recovery	1	Many	Many	Many	8	92	Complete
4	3	Streptococcus filtrate	1	2/3	Death	1	Many	Few	Few			None
5	3	Dextrose broth	1	2/3	Recovery	1	Few	Many	Moderate	12	88	Moderate
6	3	Dextrose broth	1	2/3	Recovery	1	Many	Moderate	Many	84	16	Moderate
7	3	1 per cent sodium chloride	1	1/3	Recovery	1	Many	Many	Moderate	84	16	Marked
8	3	1 per cent sodium chloride	1	1/3	Recovery	4	Few	Many	Few	40	44[2]	
9	3	10 per cent glucose	1	1/3	Recovery	2	Many	Many	Many	Unknown	Majority	Marked
10	3	10 per cent glucose	1	1/3	Death[1]	3	Few	Moderate	Few	10	90	Marked
11	3	Streptococcus filtrate	1	1/3	Death	1	Many	Few	Few			None
12	3	Dextrose broth	1	1/3	Recovery	3	Many	Many	Many	58	62	Marked
13		Control			Death	1	Few	None	Few			None

[1] Death from hæmolytic streptococcus pneumonia, pericarditis, and purulent peritonitis.
[2] Sixteen per cent lymphocytes.

covering. By transmitted light, the unfolded omentum appeared as a thin, white membrane with many small, branching blood vessels surrounded by a narrow zone of milk-colored tissue, the so called milk spots or *taches laiteuses*. Minute caseous particles were found in a few of the omentums that were immune, but the appearance as a whole is strikingly different from that of the non-protected omentums which were either grayish or hæmorrhagic, and in which there were areas of necrosis or of miliary abscesses.

A microscopic study of these omenta, stained by the hematoxylin and eosin or Gram method, showed marked histological differences, depending on the previous preparation of the animals from which they were taken (Table II).

Sections of omenta from immune rabbits showed moderate to heavy infiltration of macrophage cells with marked phagocytic activity, whereas the number of polymorphonuclear leucocytes contained in them might vary from many to few (Figs. 2 and 3). In studying the sections of the omenta from non-immune animals, I was impressed by the small number of macrophages seen and the large number of polymorphonuclear leucocytes scattered throughout or massed together in many places, forming miliary abscesses (Fig. 4).

The study of omental sections from the animals in the groups prepared over the shorter periods of time is intensely interesting because here were found sections from prepared animals, some of which survived and some of which succumbed to the test inoculation. In the prepared animals which died, the omenta contained slightly heavier infiltration of macrophages than was noted in the control animals, but the actual number was still small. Practically all of the free cells of the omenta were polymorphonuclear leucocytes, which were often seen as masses of disintegrating cells. The difference between this picture and that seen in the sections from surviving animals is one of degree, and seems to be essentially an increase in the total number of macrophages present in the latter. It would seem that in the animals undergoing

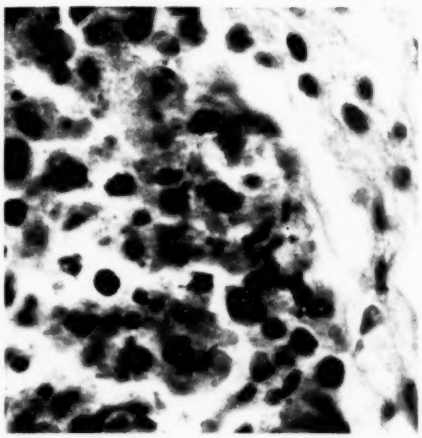

Fig. 4. A mass of disintegrating polymorphonuclear leucocytes, with few macrophages, in the omentum of a rabbit that died from intraperitoneal inoculation (hematoxylin and eosin, ×1000).

Fig. 5. Distribution of macrophages in the omentum of an immunized rabbit 4 days after inoculation (hematoxylin and eosin, ×200).

the short period of immunization a degree of reaction is found following inoculation, which is borderline between that which occurs in local immunity and that which occurs in the absence of such immunity.

In the sections of omenta taken from immune animals 1, 2, 3, and 4 days, respectively, after inoculation, a progressive increase in the number and percentage of macrophages was apparent. In those sections taken on the second day after inoculation the distribution of macrophages was uniform, and there was usually a preponderance of polymorphonuclear leucocytes (Fig. 2). In sections taken on the third day after inoculation there was decrease in the number of polymorphonuclear leucocytes and an increase in the number of macrophages, which were more numerous adjacent to the blood vessels. In sections from animals killed on the fourth day after inoculation there was an extensive grouping of the small macrophages about the blood vessels and a less heavy infiltration of cells throughout the section (Fig. 5). There was suggestive evidence in some sections that these small macrophages might be budding from the endothelium of the blood vessels, but no definite studies were made concerning them. The exact rôle which the macrophages play in the production of immunity is also questionable, but the evidence presented suggests that they are a significant factor in establishing local protection against the invasion of infection.

In this work, no attempt was made to compare the immunity produced by indifferent substances with that which follows intraperitoneal injection of specific bacterial antigens, because the immunity produced by the non-specific substances proved adequate to protect the animals against enormous amounts of intraperitoneal infection. The injection of relatively innocuous substances, such as weak solution of glucose or physiological solution of sodium chloride, seems preferable to the injection of foreign protein or bacteria which may often result in undesirable local and systemic reactions.

The pre-operative administration of solution of sodium chloride and solution of glucose in large amounts is often desirable. Clinical tests may prove that the peritoneal cavity is a valuable additional route for the administration of these substances. Given in this way, they should serve the double duty of supplying the patient with nutritious fluids and of producing peritoneal immunity. The production of peritoneal immunity, without producing untoward reactions, would seem to justify their use for such purposes only.

SUMMARY AND CONCLUSIONS

1. Local peritoneal immunity against the hæmolytic streptococcus can be produced in rabbits by repeated intraperitoneal injection of various non-specific substances.

2. A test inoculation of sufficient dosage to kill 100 per cent of the control animals was given in all experiments.

3. The percentage of recoveries among the test animals varied proportionately to the period of immunization. Immunity was adequately established in a large percentage of the animals about 60 hours after the initial injection, and immunity was proved in 100 per cent after several days.

4. An histological study of peritoneal fluid and omental tissue indicates that this immunity is dependent on, or is associated with, the presence of macrophages.

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CLINICAL SURGERY

FROM THE MARIAHILFER AMBULATORIUM AND HOSPITAL IN VIENNA[1]

THE SURGICAL TREATMENT OF DUODENAL ULCER

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UNDER the heading of surgical treatment of duodenal ulcer there are various procedures available such as gastro-enterostomy, partial resection of duodenum and stomach, and for that penetrating ulcer which cannot be resected there is resection of the stomach for exclusion of the ulcer. We have chosen as a subject "The Surgical Treatment of Duodenal Ulcer" featuring principally the "resection for exclusion" because the immediate and permanent results are so favorable that the method is entitled to wider adoption.

Gastro-enterostomy has given little satisfaction and very unsatisfactory permanent results in the hands of many surgeons. Von Haberer, as an illustration, gives only 37 per cent of his cases as remaining symptom free over a continued period of time. In the remaining percentage of his cases the ulcer persisted, did not heal, or there arose the added complication of a gastrojejunal ulcer. Schloffer gives 50 per cent of his cases in the same category.

With the material in the clinic here, gastro-enterostomy in gastric or duodenal ulcer has not been performed in 10 years except in a rare case of non-complicated duodenal ulcer in an aged patient if the referring physician was absolutely against a resection.

In a study of the last 619 cases of ulcer the frequency of gastro-enterostomy is found to be about as follows: resections for duodenal ulcer, 516; resections for gastric ulcer, 90; gastro-enterostomy for duodenal ulcer, 13—showing a percentage of 2.1 per cent gastro-enterostomies.

During this series there were performed an additional 12 gastro-enterostomies in the following types of cases: acute perforation of a duodenal ulcer and acute hæmorrhage in a non-resectable ulcer. In spite of operation death occurred in 7 of these cases of gastro-enterostomy: 2 from absolute stenosis of the pylorus followed by inanition, 1 from embolism of the pulmonary artery secondary to a femoral thrombosis.

Of the remaining cases of gastro-enterostomy only 5 cases are strictly symptom free, 4 are improved only to the extent that they are symptom free as long as they restrict their diet. The remainder are unhealed, 3 being subject to repeated hæmorrhages and all have developed a gastrojejunal ulcer. Three of these latter have been reoperated upon and the ulcer has been demonstrated.

It appears worthy to note that the more recent literature from England and America indicates fewer favorable permanent results than was formerly reported. Conspicuous examples are Pannet, of London, reporting 31 per cent unfavorable results; Lewisohn, of New York, reporting 50 per cent failures and 24 per cent of these developing a gastrojejunal ulcer; while Karl Meyer, of Chicago, observed that as high as 35 per cent of patients develop a gastrojejunal ulcer following gastro-enterostomy.

The resection of the duodenal ulcer itself which was formerly thought to be much more dangerous than the resection of a gastric ulcer has found increasing popularity, so that today in Austria and also in Germany it has come to be the method of choice. This has been more or less since the publication of the works of Clairmont and von Haberer in 1917, advocating it.

If an ulcer of the anterior wall penetrates into the pancreas so that the excavated pancreas forms the floor of the ulcer then, in order to avoid an opening into the duodenum and an infection resulting from it, the excision of the ulcer base from the pancreas, as in a malignant tumor, is not only extremely difficult from a technical standpoint but is also dangerous, because any lesion of the pancreas may very easily lead to an acute necrosis of the pancreas. This is as was formerly advocated by Clairmont and von Haberer and other surgeons.

As an illustration, Clairmont reported 5 deaths from necrosis of the pancreas in his first 100 cases of resection of the duodenum. We have never removed the ulcer base or floor in a penetrating

[1] Primiarius Dr. W. Zweig, director.

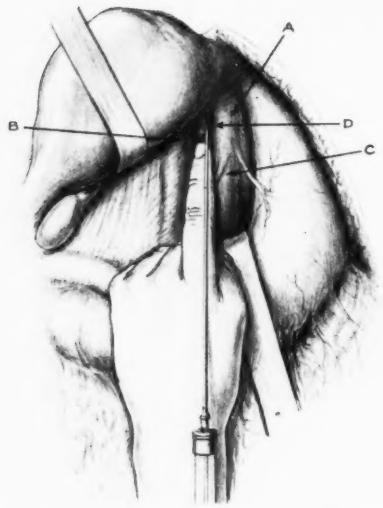


Fig. 1. Drawing showing *A*, aorta; *B*, vena cava; *C*, hepatic artery; *D*, site of injection over eleventh or twelfth dorsal vertebra.

ulcer but rather have separated the ulcer border away from the liver or pancreas leaving the base and then closing the hole in the duodenum or stomach temporarily by suture, and proceeding with the resection. Contamination of the field of operation by the acid stomach contents can be prevented by shutting off the stomach from the pylorus with a wide clamp. The use of the suction apparatus directly in the area while the dissection is going on will also absorb what little stomach contents may come into the field.

A small amount of stomach contents leaking into the field while the ulcer is being resected is not alarming as we do not believe the gastric contents to be highly infectious, as we have seen cases of perforation in which the entire abdomen was filled with the acid stomach contents at the time of operation, but which healed without any evidence of infection, and in which only a mechanical cleansing of the abdomen had been done. These patients had been operated upon within 12 hours of perforation, however, and bacterial changes had probably not yet had time to take place.

In the clinic material here, there has not been one death from peritonitis following resection of an ulcer by the method mentioned. The few instances of death from peritonitis have been in cases of ulcer of the anterior wall and have been due to infection from without.

In cases in which the ulcer penetrates the pancreas and extends far outward, that is to say as far as the ampulla of Vater, and it is impossible to isolate the common bile duct from the callus infiltration of the ulcer, then the resection of the ulcer is not only extremely difficult technically but is also dangerous to life because of the impossibility of making a satisfactory and safe closure of the duodenum. The suture usually gives way, and peritonitis ensues with fatal termination or the development of a duodenal fistula. In a case in which the ulcer has invaded the common bile duct the latter may be eroded and have an opening in the ulcer base so that a spontaneous choledochoduodenostomy has been made. If during the operation this lateral opening is overlooked in the resection of the ulcer there will occur either a diffused biliary peritonitis or at least the development of a biliary fistula which may later require a second operation. When the erosion of the choledochus is noted during the resection then, as a lateral suture of the bile duct is impossible without incurring a stenosis, it becomes necessary to ligate the common duct completely and implant the central stump into the descendent portion of the duodenum or after ligature of the duct to perform an anastomosis between the gall bladder and the duodenum. In those cases in which the common duct cannot be isolated from the callus infiltration of the ulcer, we are unable to determine whether the duct is eroded laterally or not. Therefore the ulcer is left *in situ* and the "resection for exclusion" is performed.

The "resection for exclusion" which Professor Finsterer has practiced for 14 years and which he described in 1918 in *Zentralblatt fuer Chirurgie* consists in the following: The antrum is severed two fingerbreadths centrally from the pylorus, the distal part is closed by suture in two layers, and is then covered by the gastrocolic omentum. Then two-thirds of the proximal part of the stomach is resected. Complete severance of the antrum excludes the ulcer from the acid stomach contents provided retrograde filling of the duodenum has been prevented by a correctly made anastomosis. In this manner even the largest penetrating ulcer will completely heal in a short time. In one such case the patient died 7 weeks after the first operation from an acute gangrene of the gall bladder and multiple liver abscesses. The autopsy showed that the ulcer base was completely healed. Removal of the antrum, which represents the motor of the secretory apparatus, and removal of the mucous membrane of the pars media of the stomach, wherein the hydrochloric acid is se

creted, permanently removes the hyperacidity, and in this way the recurrence of a gastrojejunal ulcer, which is the usual cause of a relapse after a resection for exculsion, is avoided.

The technical operative procedure in a case of clinically diagnosed duodenal ulcer is about as follows: One hour before operation the patient is given .02 grams pantopon; just prior to coming to operation .015 to .02 grams morphine is given with .0005 grams atropine. The amount of morphine may sometimes be lessened, dependent on the state of health of the patient, or for other reasons. It is used mainly to overcome any nervousness or apprehension on the part of the patient.

An exact block anæsthesia of the abdominal wall is made so that an absolutely painless opening of the abdomen in the midline is possible.[1] The abdomen is opened with a midline incision, ensiform to umbilicus. In order to make the anæsthesia more complete a one-half per cent solution of novocain-adrenalin is injected into the peritoneum of the abdominal wall from within, as far as possible away from the midline. Local injection of the splanchnic plexus is then made by means of a long needle which is inserted between the vena cava and the aorta above the level of the hepatic artery and which lies on the body of the eleventh or twelfth dorsal vertebra. Seventy cubic centimeters of a one-half per cent solution of novocain-adrenalin is injected here.

When the anæsthesia is completed the stomach and duodenum are examined from without. A chronic ulcer of the anterior wall is easily demonstrated either by the radiating lines of scar tissue or by the formation of pseudodiverticula lying either on the side of the lesser or greater curvature. In addition, large callus infiltration of the hepatoduodenal ligament is often found. The ulcer on the posterior wall, however, is not easily demonstrated especially if flat. It is not visible externally, and if it lies far outward and penetrates into the pancreas it is particularly difficult to demonstrate and is very easily overlooked when it is actually present.

In order to overcome this difficulty, it has been the custom to do a gastrotomy, i.e., make a small incision in the antrum, then with the right index finger (without a rubber glove) enter and palpate the stomach wall from within and, through the pylorus, palpate the duodenal wall as far as the papilla. This procedure has repeatedly demonstrated ulcers in the descendent part of the duodenum near the papilla, particularly small

[1] For complete technique see Finsterer: Local Anæsthesias, Methods and Results in Abdominal Surgery. Translation by J. Burke.

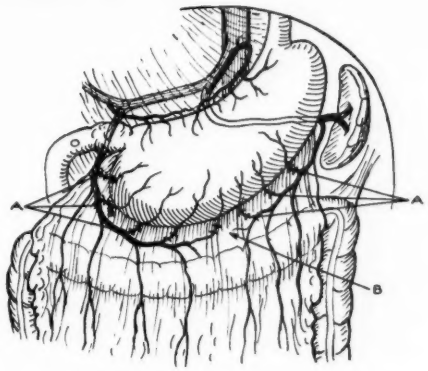


Fig. 2. Drawing showing *A*, ligation of right and left gastro-epiploic arteries; *B*, middle of stomach, arcade missing.

posterior ulcers penetrating into the pancreas which, from the external findings alone, would have been completely overlooked.

In an ulcer penetrating the pancreas, the question is then to decide whether the ulcer can be resected without too great danger to the patient. The adhesions between the descending part of the duodenum and the gall bladder, which are usually present, are separated, then the peritoneum of the posterior abdominal wall is incised at its junction with the lateral wall of the duodenum, and the duodenum is thus sufficiently mobilized to determine whether or not the ulcer on the posterior wall involves the papilla. Then the margin of the hepatoduodenal ligament is incised, the common bile duct is exposed, and its course with relation to the posterior duodenal wall and the ulcer outlined and examined. If it is then determined that the ulcer does not involve the papilla and that the common bile duct can be isolated from the callus ulcer infiltration, then resection of the ulcer can be performed without undue danger to the patient.

The resection itself begins with the detachment of the gastrocolic ligament from the stomach. Each individual vessel running from the left and right gastro-epiploic arteries to the stomach is ligated close to the stomach, the arteries themselves remaining intact. No division is ever made by mass ligation below the arch. When ligature of the vessels of the gastrocolic omentum is made below the arch the omentum becomes dusky and necrotic, because the anastomoses passing to the transverse colon and to the middle colic artery do not furnish a blood supply sufficiently rich for the omentum, especially one which is rich in fat. On

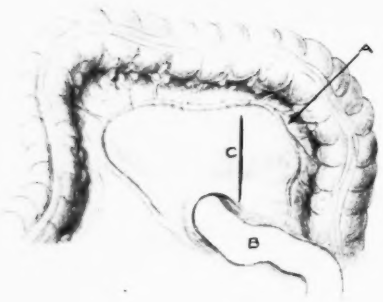


Fig. 3. *A*, Left colic artery; *B*, jejunal loop; *C*, slit in transverse mesocolon.

the right side this separation of the gastrocolic ligament extends as far as the duodenum, on the left side a hand's breadth above the middle of the greater curvature. We recognize the middle of the greater curvature as that part in which the arcade of vessels is missing and in which the small arteries run toward the stomach and toward each other.

The next step is the separation, in like manner, of the hepatoduodenal ligament and the lesser omentum from the stomach. Before the duodenum is detached from the pancreas, and if it has been determined to do a Hofmeister-Finsterer modification of the Billroth II operation, the first jejunal loop is looked for and fixed with guide suture. A slit is made in the transverse mesocolon close to the left colic artery from the base toward the arch, and through this slit is passed the jejunal loop and the stay suture is clamped for later identification. The left and right borders of the slit are likewise marked with guide sutures. The transverse colon, with the greater omentum, is then returned to the abdominal cavity and covered with a sterile compress.

The duodenum is then detached from the pancreas, a relatively easy procedure when the ulcer is on the anterior wall. In those cases of penetrating ulcer the posterior wall of the duodenum is separated from the pancreas and the callus base. This is done best by knife resection keeping as close as possible to the duodenal wall in order not to injure the pancreas itself. This procedure produces a round hole with hard margins in the posterior wall of the duodenum corresponding to the base of the ulcer which has been left behind. This is at once closed by several sutures made diagonally to the longitudinal axis of the duodenum.

The deep excavated floor of the ulcer in the pancreas is mechanically cleansed with sublimate solution or sponged with alcohol. The cautery is never used to cauterize the base, as experience has shown that in the casting off of the eschar a large pancreatic vessel touched by the cautery and not sufficiently closed by thrombus may begin to bleed and cause no little trouble.

Only when the distal margin of the ulcer is sharply separated from the pancreas is normal duodenal wall visible, so that it is necessary to separate the pancreas from the duodenal wall until at least 1 centimeter of normal duodenum is provided. While doing this, special attention must be paid to the accessory pancreatic duct which must not be injured in the dissection nor caught in a ligature because in some cases this duct may constitute the chief excretory duct of the pancreas. After the pancreas has been separated from the duodenum, a crushing clamp is applied to the duodenum 1 centimeter proximal to its lowest dissected edge and the clamp is then removed and the duodenum ligated in the furrow made by the crushing. One centimeter distal to this ligature, a pursestring suture is applied which remains temporarily untied. In order to keep a grasp on the duodenum, two stay sutures are applied 2 to 3 centimeters distally, one on the superior wall and the other on the inferior wall. One centimeter proximal to the ligature of the duodenum, a clamp is applied and, between this clamp and the ligature, the duodenum is divided by means of the cautery. The proximal part is covered with sterile gauze and turned up out of the way. The distal part is held by means of the two stay sutures by the second assistant while the first assistant invaginates the stump into the duodenum and the pursestring suture is closed and tied by the surgeon. Over the pursestring suture two or three Lembert stitches are made, bringing always peritoneum to peritoneum and invaginating the posterior wall, which is free, of peritoneum. A suture is then made which takes in the edge of the hepatoduodenal ligament and the hepatocolic ligament and the duodenal stump in such manner that when it is closed or drawn together and tied the duodenal stump becomes buried under, i.e., becomes retroperitoneal and covered over.

The resection then proceeds to the stomach and the left gastric artery must be ligated where it approaches the stomach after being given off the cœliac trunk. A point is made of doubly ligating here in order to prevent any later mishap by a possible slipping of the ligature, as a secondary hæmorrhage from so large a vessel in such close proximity to the aorta would be fatal before any

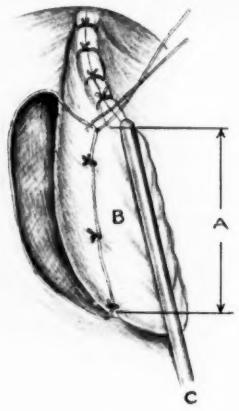


Fig. 4.

Fig. 4. Drawing showing *A*, left border of mesocolon slit; *B*, posterior wall of stomach; *C*, clamp on lower 10 centimeters of resected stomach edge to be used in anastomosis.

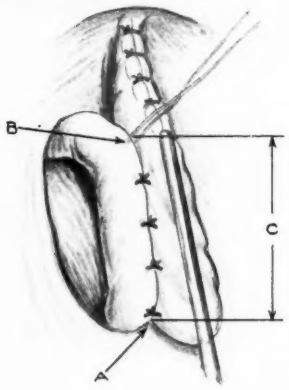


Fig. 5.

Fig. 5. *A*, First layer of Lembert sutures; *B*, approximate point of first stitch; *C*, width of anastomosis.

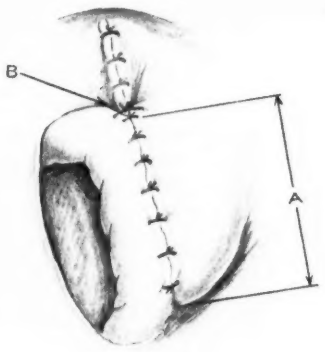


Fig. 6.

Fig. 6. *A*, Anastomosis completed; *B*, first three angled suture.

surgeon could stop the bleeding by any reoperation. A Payr stomach clamp is then applied obliquely to the axis of the stomach from the lesser curvature near the cardia to the greater curvature near the gastrosplenic ligament. In this manner the line of separation of the stomach lies in the line of the direct continuation of the œsophagus. Just below the Payr clamp and proximally, the stomach is closed by a through-and-through continuous suture from the lesser curvature to as far as a point 10 centimeters from the greater curvature.

Three 10 centimeter clamps are applied distally to the Payr clamp completely closing off the stomach. The separation of the stomach is made by dividing with the scalpel between these clamps and the Payr clamps leaving a slightly larger margin of tissue toward the greater curvature. The resection is thus completed and there remains the anastomosis to be made.

A curved Doyen clamp is applied to the unclosed lower portion of stomach proximal to the Payr clamp but several centimeters away. Grasping the excess border of the lower part of the stomach edge with a tooth forceps, the Payr clamp is removed by the first assistant. At the same time the lower part of the stomach, which was not sutured, is caught temporarily by the surgeon with a broad 10 centimeter clamp. The Doyen clamp is now removed and the upper part of the stomach, which has previously been sutured through and through, is covered by two rows of interrupted sutures inverting the corner by means of a U suture.

Care should be taken here that the proximal part of the stomach especially that between the Doyen clamp and the clamp on the stomach edge is empty, otherwise the mucous membrane is pressed against the seromuscularis from within and, in the fixation of the mesocolon slit to the posterior stomach wall or in making the first row of Lembert sutures, it is possible for it to be caught in the suture. This would be dangerous as peritonitis would inevitably follow. With this in mind the left border of the mesocolon slit is fixed to the posterior wall of the stomach by means of three or four interrupted sutures. The anastomosis is then made between the resected border of stomach and the first jejunal loop by means of three layers of sutures (Fig. 4). The anastomosis is about 10 centimeters in width.

It is especially important at this point that the jejunal loop should lie in correct apposition to the posterior wall of the stomach, the afferent portion, which is fixed to the ligament of Treitz, must lie on the lesser curvature, and the efferent portion, which is mobile, on the greater curvature. The loop should not be taken too short nor too close to Treitz' ligament in order to avoid any kinking which may occur when the stomach stump is small or lies high up under the diaphragm or when the plica duodenojejunalis lies very deep. The loop also must not be made too long or the afferent portion may sag and favor retrograde

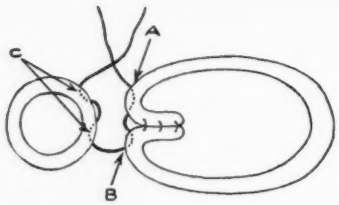


Fig. 7. Cross section of stomach and jejunum illustrating three angle suture. *A*, Anterior stomach wall; *B*, posterior stomach wall; *C*, twice grasping jejunum.

filling. The approximate distance on the jejunal loop from the plica duodenojejunalis in which to make the first stitch is generally from 3 to 6 centimeters away, depending on the position of the plica, the size of the stomach stump, and the degree of ptosis of the stump.

The first row of Lembert sutures is made interrupted, silk being used. The seromuscular layer is made with a continuous running suture of chromic catgut and when this layer is completed the clamp closing the opening into the stomach is removed and the Doyen clamp above it is released slightly in order that bleeding vessels in the mucous membrane may be caught and ligated. If at this time any stomach contents escape the suction apparatus is used to aspirate it. With no clamp applied to the jejunal loop, the jejunum is opened and any bleeding vessels in the mucous membrane are caught with hæmostats and ligated. Any bile present is also removed with the aspirator or, if only slight, is simply swabbed out.

The mucous membrane layer of stomach and jejunum is then sutured with a continuous chromic catgut suture which is locked in each stitch in order to prevent hæmorrhage. The seromuscularis layer of the anterior wall is closed by a continuous chromic catgut suture in the upper portion while in the lower part interrupted sutures are used in order to prevent any tendency to stenosis which if any is at this point.

In order to overcome the insecurity of the three angle corner where the stomach closure suture meets the anterior and posterior suture of the anastomosis, a special suture is made which grasps first the anterior wall of the stomach, then the posterior wall, then grasps twice the jejunal loop and draws this together in such manner that when tied the jejunum lies broad against this three angled corner and completely covers it. By making an additional one or two of these sutures above the first, the afferent loop is fixed higher on the stomach. In this manner retrograde filling of the duodenum is overcome—a very important

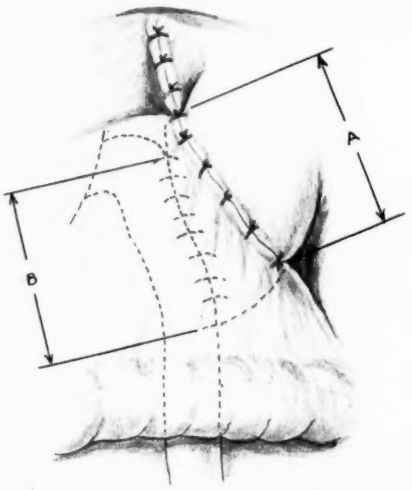


Fig. 8. *A*, Right border of mesocolon slit sutured to anterior stomach wall; *B*, line of anastomosis completely covered with mesocolon.

factor, as any retrograde filling following operation can cause the closure suture of the duodenal stump to give way because of the increased pressure. In those cases of "resection for exclusion" where the pylorus is left intact, retrograde filling will prevent the healing of the ulcer and thus the operation will fail to help the patient.

When the anastomosis is completed, the right side of the mesocolon slit is drawn over the anastomosis and fixed to the anterior stomach wall with 4 to 6 interrupted sutures, so that the operative field above the mesocolon is completely shut off from the free abdominal cavity—a particularly important step when the ulcer base has been left *in situ* or if there has been any escaped stomach contents in the field (Fig. 8).

The anastomosis itself, which during the operation was in the upper abdominal region, lies now in the free abdominal cavity. It is important that the mesocolon slit should not be fixed to the anastomosis suture but at least two fingerbreadths above it and fixed to the stomach wall; otherwise an obstruction of the anastomosis by pressure or contraction will take place (Fig. 9).

In order to prevent any ptosis of the transverse colon or any adhesion of it to the anterior abdominal wall, the gastrocolic ligament is caught below the gastro-epiploic arteries and by means of two or three interrupted sutures is fixed to the

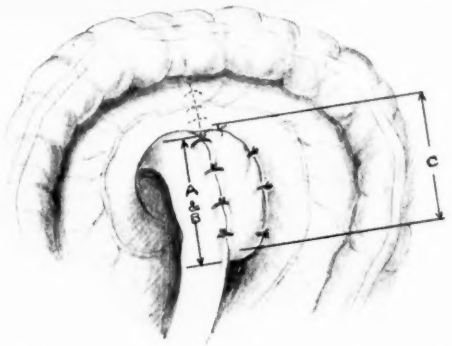


Fig. 9. *A*, Anastomosis lying below mesocolon in free abdominal cavity; *B*, line of anastomosis; *C*, left border of mesocolon slit sutured to posterior stomach wall.

peritoneal covering of the pancreas and to the base of the mesocolon.

As a rule, the abdomen is closed tightly in three layers. However, in a case of a penetrating ulcer in which the base has been left behind, a rubber drainage tube is inserted, which from the fourth day on is shortened a bit each day and is entirely removed in a week, provided there is no marked pancreatic secretion present, which occurs only very rarely. If in old patients there is oozing or accumulation of blood or a bleeding vessel cannot be located, a drainage tube is inserted for 24 hours so that the blood is evacuated outward.

If the duodenal ulcer, due to its location and extension, cannot be resected, the "resection for exclusion" is performed. In this operation the gastrocolic ligament is detached from the stomach for only two fingerbreadths proximal to the pylorus and the lesser omentum the same. At this point, the antrum is severed from the pylorus between two clamps. The proximal part is covered with sterile gauze and turned out of the way while the distal part, held by the clamp, is first closed with a through-and-through suture and then covered over by Lembert sutures. This stump is covered with the remainder of the gastrocolic ligament and the small omentum. The lesser omentum is then ligated toward the cardia and the left gastric artery is ligated in the typical place as before described. The stomach is divided in the usual place as in a typical resection and an end-to-side anastomosis made with the first jejunal loop. In a case in which there is well marked hypertrophy of the musculature the line of separation of the antrum must be farther away from the pylorus (three fingerbreadths) in order to make the Lembert sutures without any stretching or tension. In these cases the mucous membrane from the eliminated portion of the antrum is removed as far as the pylorus and there closed by a suture. The seromuscularis is cut on the side of the greater and lesser curvature making thus an anterior and a posterior flap which is overlapped and fastened by suture over the mucous membrane suture in order to make a safe and sure closure.

Fig. 10. Resected antrum including pylorus.

If the ulcer is located in the descendent portion of the duodenum and near the papilla, the pylorus also is removed in addition to the antrum; the duodenum being severed close to the pylorus. The wound is closed by a through-and-through suture, and is then covered by Lembert stitches. The suture line is then covered with the gastrocolic ligament and the hepatoduodenal ligament. The left gastric artery is ligated in the usual place and the typical stomach resection is made, and an end-to-side anastomosis of stomach to first jejunal loop. In these cases the abdomen is always drained (Fig. 10).

The anastomosis practiced by us has a distinct advantage over the anastomosis of the whole width of the stomach as described by Pólya and Reichel, in that retrograde filling of the afferent loop and of the duodenum is avoided. This is because the afferent loop is fastened upward and at a higher level than the efferent loop when the sutures are made at the three angled corner so that the anastomosis is in the direct line of the œsophagus and so that, when the patient is in the standing position, the loop does not become turned or fallen (Figs. 11 to 14).

If one makes an anastomosis with the whole breadth of stomach as in the Pólya-Reichel method, especially in cases in which only the antrum is resected, the stomach, which before was fastened to two fixed points (œsophagus and duodenum), is now freely movable on the right side and when the patient sits or stands can become turned to such a degree that there occurs a

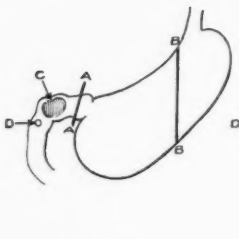


Fig. 11.

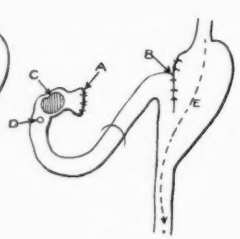


Fig. 12.

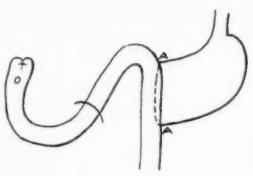


Fig. 13.

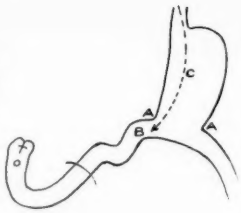


Fig. 14.

Fig. 11. Finsterer resection, antrum removed. *A*, Line of resection at pylorus; *B*, line of resection of stomach; *C*, ulcer; *D*, papilla.

Fig. 12. Finsterer resection, patient standing. *A*, Suture of pylorus covered with Lembert stitches; *B*, obliteration of three angled corner and fixing of afferent loop at a higher level by means of same stitches thus overcoming retrograde filling; *C*, ulcer; *D*, papilla; *E*, arrow which shows direct continuity of œsophagus, stomach, and jejunum.

Fig. 13. Pólya-Reichel resection. *A*, Anastomosis entire breadth of stomach.

Fig. 14. Pólya-Reichel resection, patient standing. *A* Anastomosis entire breadth of stomach; *B*, showing afferent loop at same level as efferent making retrograde filling easily possible; *C*, arrow shows possible direction of food current.

stretching of the small curvature. This causes the afferent loop to assume the same level as the efferent and the food moving forward along the lesser curvature will reach the afferent loop instead of the efferent. In order to overcome this defect in the operation, Reichel suggested that an entero-anastomosis be made between the ascending part of the duodenum and the efferent jejunal loop. This, however, favors the occurrence of a gastrojejunal ulcer in the jejunal loop lying above the entero-anastomosis. Due also to the danger of a gastrojejunal ulcer an anti-colic anastomosis, in which an entero-anastomosis is always necessary, is never performed here.

In the cases of "resection for exclusion" with excision of the mucous membrane the abdomen is always drained because of the possibility of an insufficiency in the suture line closing the antrum, in which case the duodenal contents must have an outlet through the abdominal wall; otherwise the life of the patient is in danger. Drainage is also always used in those cases of "resection for exclusion" with removal of the pylorus in which the suture line closing the duodenum is made in inflamed tissue which is very unreliable, a slight tearing away allowing enough leakage to cause a diffused peritonitis if there is no drain, whereas with drainage the worst that may occur is a duodenal fistula which will heal spontaneously (Figs. 15 and 16).

The Billroth I type of operation, which, since its recommendation by von Haberer, is used by many leading German surgeons (Friedemann) in cases of duodenal ulcer, seems dangerous because when a sufficient separation of the duodenum from the pancreas is made the posterior wall of the duodenum is free of peritoneum. This with the extensive resection of the stomach, which is necessary to prevent a recurrence of the ulcer causes too great tension in the bringing together of the duodenum and stomach and the cutting through of the sutures is not uncommon. The possibility of peritonitis from an insufficient suture line is always present. For this reason the Billroth I method is rarely used here in this clinic in cases of duodenal ulcer, e.g., there were 24 cases in the last 10 years.

In cases in which there is a long, mobile, descending part of duodenum with a ptosis of the stomach, we make use of the modification of the Billroth I operation as described by von Haberer. This modification consists in anastomosing the stump of the stomach to the lateral wall of the duodenum, an end-to-side anastomosis or terminolateral gastroduodenostomy (Figs. 17 and 18).

In our material the upper part of the stomach is closed and the anastomosis is made with the lower half (von Haberer uses the entire breadth of stomach) because, in using the whole breadth of stomach lumen, the contracting sutures produce a series of folds in the stomach which may favor the occurrence of a relapse.

The terminolateral gastroduodenostomy is superior to the Billroth I method in that the stenosis, which occurs fairly often after this latter method and requires re-operation, does not occur. Second, less of the stomach need be resected than in the original Billroth I method, because if the gastric contents still contain any efficient free hydrochloric acid after the operation it enters the duodenum at a point below the papilla of Vater

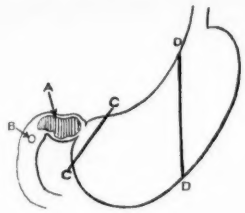


Fig. 15.

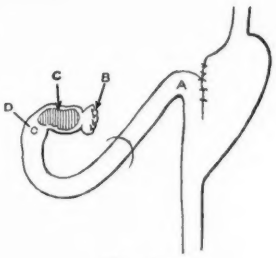


Fig. 16.

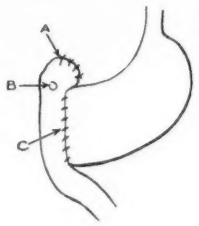


Fig. 17.

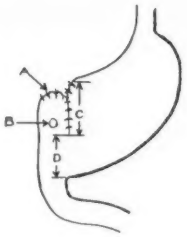


Fig. 18.

Fig. 15. Finsterer resection (antrum left *in situ*). *A*, Ulcer; *B*, papilla; *C*, line of resection leaving antrum and pylorus; *D*, typical line for resection of stomach.

Fig. 16. *A*, Showing typical anastomosis and position of the afferent loop; *B*, pylorus left *in situ*; *C*, ulcer; *D*, papilla.

Fig. 17. Typical von Haberer modification of Billroth I. *A*, Duodenal stump; *B*, papilla; *C*, line of anastomosis using full breadth of stomach.

Fig. 18. Billroth I modification used by Finsterer. *A*, Duodenal stump; *B*, papilla; *C*, upper portion of stomach closed by suture; *D*, lower portion anastomosed with duodenum.

not above it as in the Billroth I method, and therefore it is at once neutralized by the alkaline bile and pancreatic juice. The terminolateral gastroduodenostomy is especially favored in young people who live in the eastern countries under poor hygienic conditions and who are more or less liable to infections such as typhus, dysentery, and cholera.

The von Haberer modification shares also with the original Billroth I method the danger of insufficiency of the suture line when the sutures are made under undue tension and there is insufficient power of regeneration in the tissues. Also there is the danger of a stenosis occurring by a kinking of the duodenum at the point where the descending and ascending portion join. In the resection for exclusion the terminolateral gastroduodenostomy is used when the descendent part of the duodenum is long and easily mobilized, but in cases of ulcer extending to the papilla this is only rarely possible. In our own material there were only 6 cases. The only advantages over the usual end-to-side anastomosis with the first jejunal loop is that the amount of stomach which it is necessary to dissect in order to obtain the same permanent end-result is much less.

AFTER-TREATMENT

In all cases of resection in order to obtain the best results from the operation, the after-treatment is equally important as the exact performance of the operation, especially in old people with chronic bronchitis, emphysema, etc.

For the first 24 hours after the operation the patient receives only a Murphy drip of either salt solution or 5 per cent glucose. In the next 24 hours, a tablespoonful of an alkaline mineral water or of cold tea is given by mouth every half hour. If there has been no vomiting after 48 hours the patient is given tea with milk in larger quantities so that after the fourth day a diet of milk, milk gruel, mashed potato, and tea with milk is allowed. This is increased according to the need of the patient until a point is reached in about 2 weeks when finely minced meat is added to the diet.

In cases of postoperative hæmatemesis, the stomach can be washed out with the stomach tube, iced water being used even on the first day, with no danger to the suture line. This usually takes care of the bleeding, but if not a second washing is done and followed by using about 100 cubic centimeters of a 1:1000 solution of nitrate of silver which can be repeated once. Intravenous calcium and subcutaneous injection of horse serum is also sometimes used.

A re-laparotomy for arrest of hæmorrhage is quite difficult and usually of little value as a hæmorrhage from a small vessel in the mucous membrane can hardly be detected. In our material there is only one death from postoperative bleeding. That occurred 36 hours after operation in a case of penetrating ulcer of the duodenum in a patient who also had a severe alcoholic cirrhosis of the liver. It is probable that a blood transfusion might have saved this case but it was not available at the time this patient was operated upon.

The severe degrees of atony of the stomach or intestine such as are not infrequent in operations done under narcosis are entirely absent when local anæsthesia is used. Gas is freely discharged from the bowel in from 24 to 48 hours after operation. In those patients who have been subject to severe chronic constipation or in those who have acquired a morphine or opium habit and

therefore must have large doses of narcotic after operation, meteorism sometimes occurs and is combated by using dry hot air, washing out of the intestine with warm water (temperature must be 40 degrees C. to be effective), and pituitrin given 2 or 3 times daily.

If there exists a peritonitis due to an infection introduced from without, unfortunately we have found any treatment powerless, even enterostomy which is so effective in those cases of post-operative narcotic atony. It has been tried repeatedly but without success.

It is important that aged patients, poorer class laborers and similar types, all of whom suffer more or less from chronic bronchitis, should be taught to breathe deeply and regularly after operations and especially to cough while at the same time a nurse supports and helps them by making pressure with her hands against the recti muscles, in this way preventing any tension on the freshly sutured wound.

As the effort of coughing is thus free from pain, less morphine is required, which is favorable to the patient. Although morphine lessens pain, at the same time it does away with the irritative cough which is productive; therefore morphine favors stasis and is harmful. Expectoration is also encouraged by the regular application of warm camphorated oil to the chest. In the last year we have been using transpulmin, a quinine derivative, as a prophylactic against pneumonia and have given this twice daily. Patients over 60 years of age must be gotten out of bed on the second or third day after operation and allowed to sit in a chair for short periods. In the following out of this postoperative scheme of treatment we have found that many complications are avoided. In our material there have been but 3 deaths from pneumonia in the last 1,312 cases of resection for ulcer. It is curious to note that elderly people seem to give most favorable results, as in a series of 60 cases of resection of duodenal ulcer in patients all over 60 years of age and ranging from 60 to 77 years in age there were no postoperative complications and no deaths.

END-RESULTS AND MORTALITY

Fortunately, deaths from pulmonary embolism have been rare in this clinic, only 2 cases occurring after resection for duodenal ulcer. The possible explanation for this may be in the use of local anæsthesia which does not harm the patient's heart in any way or in the fact that all patients are put to bed after operation in a slight Trendelenburg position with the trunk elevated in order to avoid congestion in the lungs and the trunk. The field of operation can hardly be the starting point of an embolus as the efferent veins all open into the portal vein and emboli would tend to be carried to the liver and retained there. In the 2 cases occurring here one was in a woman 49 years of age with large varicose veins. She had been up 4 days when the embolism occurred on the tenth day after operation. The other gave the usual embolism history: a young man 28 years of age apparently in the best of health, on getting out of bed on the tenth day fell over and died immediately.

The mortality after duodenal resection was comparatively high during the war (Professor Finsterer: 49 cases with 4 deaths, a mortality of 8.1 per cent). This mortality was due to lack of proper equipment, improper selection of cases due to the exigencies of the occasion and also probably due to inexperience. Since the war the mortality has been steadily reduced as shown in the following figures: There have been 566 cases of resection of the duodenum with 18 deaths, a percentage of 3.1 per cent. That the mortality in the Billroth II modification operation is less than in the Billroth I operation can be seen by the fact that 429 of these cases were the Hofmeister-Finsterer modification of the Billroth II operation with 10 deaths or a mortality of 2.3 per cent while 137 cases were either the Billroth I operation or the von Haberer modification with a mortality of 8 cases or 5.8 per cent.

In the modification of the Billroth II operation as practiced by us, if the suture is carefully made in three layers, any insufficiency of the anastomosis suture is avoided because the jejunal loop is movable; therefore, in any contraction of the stomach there cannot occur any tension in the suture line. On the contrary, in the original Billroth I method and in the von Haberer modification, if the suture line is under tension and the regenerative power of the peritoneum is insufficient, there will occur on the third to fifth days a cutting through of the suture and a dehiscence of the anterior wall. Thus a peritonitis occurs because the stomach shortened by the resection is stretched between two immovable and fixed points, i.e., the cardia above and the duodenum below. With every contraction of the stomach, therefore, there is a pull on the anastomosis suture. In our experience when the typical anastomosis described was used not only in duodenal ulcer but also in gastric and recurrent gastrojejunal ulcer, there has not been one death due to an insufficiency of the suture line.

In 137 cases of duodenal ulcer in which either the original Billroth I operation or the von

Haberer modification was done there were 2 deaths from peritonitis due directly to an insufficiency of the suture line. Also in 116 cases of gastric ulcer and in 36 cases of gastrojejunal ulcer in which the same type of operation was used, there were 4 deaths due to an insufficiency of the suture line.

In the resection for exclusion in which the pylorus was left *in situ* there were 92 cases with 2 deaths or a mortality of 2.1 per cent. In 34 cases in which the pylorus was resected, the mortality rose to 14.7 per cent. Three deaths were due to peritonitis secondary to the giving way of the suture closing the duodenal stump. In the last 6 years, however, in the cases in which the pylorus had been resected, there had not been a death due to peritonitis because in every case drainage had been used so that if the suture line gave way, which occurred in 4 cases, there occurred instead of a general peritonitis a duodenal fistula which later healed spontaneously.

After every resection for a duodenal ulcer we insist on the most careful postoperative dietary management because in all of these cases there exists a chronic gastritis which must be given time to heal. Tissue specimens will practically always show marked chronic inflammatory change.

In estimating the permanent end-results of operation, it is fair to count only cases in which 3 years have passed since operation; therefore, only cases operated upon prior to December 31, 1926, are used for statistical data. Cases lost track of or whose subsequent history after operation is unknown should not be included in the total number of cases as among these unknown cases there may be a high percentage of failures. Our experience has been that the number of cases which could not be traced for various reasons, loss of address, etc., is 6.7 per cent of the total, and it is fair to assume that among these untraced cases there may be many who do not answer our questionnaire because they are not cured and possibly have been re-operated upon elsewhere. We feel that all statistics which include 10 per cent or more of untraced cases in their total are valueless.

In 307 cases of resection for exclusion with the typical end-to-side anastomosis, 293 cases are healed after a period varying from 3 to 14 years after operation. By "healed" is meant that the patients are able to eat any food without discomfort, have gained in weight (several patients as high as 60 pounds), and that they have been able to follow their occupation. Four cases are considered as improved but not healed because there are certain foods which they must avoid or they complain of heartburn or gastric distress. These have no pain in the region of the stomach but are suffering from an old tuberculosis which was present before operation. Ten cases are classified as unhealed, that is they have not been able to resume their former occupations, and they still complained of pain and gastric distress after operation. Among these there are 4 cases in which the symptoms present were not due to a recurrent ulcer but were caused by a chronic colitis, which existed prior to operation. In 4 other cases the clinical symptoms suggested the presence of a gastrojejunal ulcer but it was not possible to prove this. In one of these cases in which a later re-operation (choledochoduodenostomy) was required a gastrojejunal ulcer was not found. In 2 cases a recurrent gastrojejunal ulcer was proved at a second operation to be the cause of the symptoms.

The first of these was a patient who had had a resection of half of a dilated stomach for duodenal ulcer in 1917, with no relief of symptoms. Six years later he was operated upon for a gastrojejunal ulcer, and at this time it was possible to remove quite a large portion of the stomach, illustrating that the first resection had not been extensive enough. This case following the second operation is now well.

The second case of gastrojejunal ulcer had been operated upon several years ago in another clinic and a gastro-enterostomy had been done. The duodenal ulcer had not healed so that a second operation was performed in this clinic. The duodenum, pylorus, and the antrum were resected as far as the anastomosis. The symptoms recurred some time after this operation and a third operation, performed in this clinic, revealed a gastrojejunal ulcer at the site of the old anastomosis. This was resected and the typical radical operation for gastrojejunal ulcer was performed. This patient died of a peritonitis subsequent to a secondary infection.

In 71 cases in which were used either the Billroth I method or the von Haberer modification, the permanent results were much less favorable. Six cases were classified as failures, or 8.5 per cent. In 2 of these cases, there was a recurrence of the ulcer which required a second operation. One case was a probable recurrence but was not re-operated upon and another case required a gastro-enterostomy to relieve a stenosis of the first anastomosis. Following this gastro-enterostomy the patient was well.

The statistics quoting the permanent end-results in the resection for exclusion must be divided into two groups. The first group includes those in which the pylorus with a small portion of the antrum was left *in situ*. In 71 cases in which this was done and which had been operated upon in the period of from 3 to 14 years ago, 63 cases are free from complaint, the body weight has increased (in some cases as high as 70 pounds), and

the operative result is satisfactory. Two cases are improved in that they are able to work and are symptom free, if they avoid certain foods which experience has taught them will cause heartburn. A third patient had complained of vague symptoms of distress after eating which entirely disappeared when the appendix was removed 6 years ago, since which time he has been symptom free. In these 3 cases only the antrum with the distal one-third of the stomach was removed. The patients are free from pain and are themselves satisfied with the operative result, so that if one were to include these 3 cases as healed the total excellent permanent results are equal to 90 per cent.

Five cases developed a gastrojejunal ulcer which required a second operation. In 3 of these done early in the series only the antrum had been resected at the first operation. In 2 of these cases in which a two-thirds resection had been done a gastrojejunal ulcer developed because the patient did not follow directions to have the gall bladder, which formed a large tumor mass with the penetrating ulcer, removed at a second operation. These 2 cases developed a gastrojejunal ulcer in spite of an extensive resection.

The second group of cases of resection for exclusion in which the pylorus was resected consists of 18 cases. Twelve cases have been symptom free over a period of from 3 to 14 years. Three cases are improved and 3 cases were considered unimproved. In 2 of these unimproved cases a previous gastro-enterostomy had been done for duodenal ulcer without relief of symptoms, and in the second operation for resection the ulcer was found to extend so far out toward the papilla that it had to be left *in situ* and only the pylorus and antrum as far as the previous anastomosis were resected.

Thus it can be seen that in the resection for exclusion where the pylorus was left *in situ* there were 90 per cent that were symptom free, while in the operation with simultaneous resection of the pylorus only 66 per cent of the cases were symptom free, showing that the permanent end-result is not dependent on the resection of the pylorus, as so many surgeons have stated. Therefore, removal of the pylorus is justifiable only in those cases in which it is without great danger to the patient.

Favorable end-results can be attained only when a large portion of the stomach is resected and also when retrograde filling of the dudoenum is avoided. This is easily possible in the method of resection as practiced by us. This is even more important in the resection for exclusion in those cases in which on account of the extensive hypertrophy of the musculature a slightly larger portion of the antrum must be left behind to insure a reliable closure. In such cases a retrograde filling of the duodenum would excite an increased secretion of gastric juice and thus cause a relapse of the ulcer.

In those cases of penetrating ulcer in which a larger portion of antrum is necessarily left *in situ*, a secondary operation can be done 6 weeks later and the excluded part of antrum, pylorus, and ulcer site easily removed, as the ulcer is completely healed. This makes in reality a two stage resection of a duodenal ulcer but is much to be preferred to the two stage method practiced by Delore in which first a gastro-enterostomy is done and then in a second operation a resection of the duodenal ulcer is made. In using this method of Delore, one would be obliged to make the gastro-enterostomy high up on the fundus so that it would not hinder an extensive resection at the second operation and experience shows that gastro-enterostomies made high up in the fundus lead to severe functional disturbances. In our material a two stage resection is done only in a case in which there occurs later an appendicitis or some gall-bladder pathology, and the patient is operated upon for this then at the same time a resection of the excluded antrum is done. From the standpoint of the patient, two less severe operations are much better than a forced resection of an inoperable duodenal ulcer with its attendant high mortality or to a simple gastro-enterostomy, with its poor permanent result. To those adherents of the neurogenic theory, who see in the leaving of the pylorus *in situ*, the etiology of a recurrence the pylorus may thus be removed in a second operation thus gratifying their theory.

The resection for exclusion gives the same good permanent end-results as the actual resection of the duodenal ulcer itself, provided a sufficiently large amount of stomach is removed. Certainly it is an indirect method but it is not a palliative method as it has been called in some of the literature. It is just as radical as the resection of the ulcer itself.

We are of the opinion that in duodenal ulcer, the primary seat of the affection is not in the duodenum itself but in the stomach, chiefly in the antrum, which only macroscopically is normal in appearance but upon histological examination exhibits chronic inflammatory changes which are the cause of the abnormal gastric juice secretion as has been shown by Stoerk, Konjetzny, and others. Therefore, if a patient with a duodenal ulcer is to remain permanently cured, the pathological changes in the stomach must be removed and this can be done with assurance only by

radical resection. This view was advanced by Okinczyc before the French Congress of Surgery in 1928.

The permanent end-results obtained in resection for exclusion so far surpass those obtained by gastro-enterostomy (advocated by von Haberer for those cases in which the ulcer cannot be resected) that this should be the method of choice.

We are also of the opinion that in duodenal ulcer the permanent end-results of resection depend entirely upon the extensiveness of the resection of the stomach and upon the permanent removal of the cause of the pathological secretion of gastric juice and not upon any special predisposition on the part of the patient against which a surgeon would be powerless. Therefore, a recurring ulcer after resection means that the resection was not sufficiently extensive and that the patient can still be cured by a more extensive resection.

As an argument against the size of the stomach resection having any significance, mention has been made in the literature of the cases of relapse even after extensive resection. It must be borne in mind that there exists a wide divergence of opinion as to what really constitutes an extensive resection. Many surgeons consider a resection extensive if in a case of duodenal ulcer they resect merely the antrum as suggested by Schur and Plaschkes in their monograph. We understand an extensive resection to be one in which at least two-thirds of the stomach is removed. It must not be forgotten also that in a case in which there is an enormously dilated stomach the dilatation consists almost entirely of antrum so that in a resection of two-thirds of a considerably dilated stomach not only the normal cardial third is left but also the entire pars media, and sometimes even a part of the antrum remains *in situ*. This certainly is not a resection of two-thirds of the stomach and does explain the reason for recurrence of the ulcer.

As an illustration we report a case from the clinic here.

A man suffering with a duodenal ulcer had had a Billroth I operation and two-thirds of the stomach had been resected, according to the history sheet from the clinic in which the operation had been done. Soon after the operation the patient's symptoms recurred. At the second operation here in this clinic a large duodenal ulcer penetrating into the pancreas was found. The ulcer extended as far as the anastomosis and in addition a large portion of stomach was adherent to the lower surface of the liver. It was posssible in this case to resect more than 10 centimeters on the lesser curvature before we reached the typical point in the vicinity of the cardia at which our resection is done. Following this operation the patient remained free from symptoms.

In this case the first operation consisted probably of a resection of two-thirds of a greatly dilated stomach but a large part of the lesser curvature was untouched as evidenced by the fact that at the second operation it was possible to resect so much. That there was a possibility that postoperative dilatation of the stomach could account for this amount of lesser curvature or for an increase in the extent of the stomach does not seem probable, especially as in this case, the stomach had become fixed to the liver making a fixed point and unless the liver enlarged at the same time as the stomach it does not sound reasonable.

The importance of the size of the resection of the stomach is also evidenced by the fact that in cases in which repeated relapses followed less extensive resections, permanent healing was obtained after a sufficiently extensive resection.

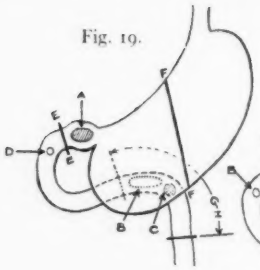
As an illustration, in 126 radical resections for recurrent gastrojejunal ulcer, we found cases in which 4 operations had been done by various methods in other clinics and only after the fifth operation, an extensive radical resection, was the patient cured.

A vivid example of this was in the cases of two brothers.

Posterior gastro-enterostomy had been done for duodenal ulcer. Soon after operation there was a recurrence of pain and repeated hæmorrhages. In 1919, in one of the brothers a radical operation for gastrojejunal ulcer was done here and at this time it was found that the old duodenal ulcer had not healed and that a new ulcer had developed on the anastomosis loop. Resection of the duodenum, the ulcer, of the pylorus and nearly half of the stomach, which was considerably dilated, plus a resection of the anastomosis loop was done. Then a Y anastomosis was made, stomach stump to jejunum (Figs. 19 and 20).

This operation brought no relief of symptoms, and the patient complained of constant pain, heartburn, and frequent hæmorrhages. Medical treatment, X-ray treatment, etc., were of no avail and the opinion of the internists handling the case was against any further surgery on the basis that this patient was probably predisposed to ulcer formation and that another ulcer operation would lead only to the formation of another ulcer. Finally the pain became so unbearable that it could not be controlled even with large amounts of morphine (as much as half a gram daily) and therefore a third operation was done in September, 1921. The brother had the same operative and clinical experience and also came to a third operation. In both cases a comparatively large stomach stump was found plus a large ulcer of the anastomosis loop deeply penetrating into the pancreas and into the mesentery of the jejunal loop. The ulcer reached exactly as far as the site of anastomosis of the afferent jejunal loop. Resection of the ulcer was done leaving the ulcer base *in situ*. Extensive resection of the stomach stump was done so that only a narrow rest of the fundus remained corresponding to about one-fifth of the normal stomach. On account of the shortness of the jejunal loop another Y anastomosis was made. Both patients were symptom free after the operation, with no pain, no heartburn, and an increase of body weight of from 30 to 40 pounds. Both are able to work and carry on their occupation without any attention being paid to diet. This

Fig. 19.



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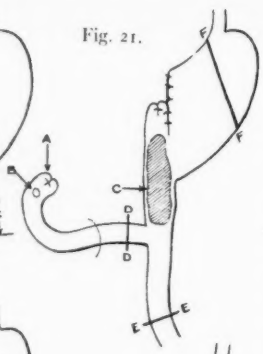

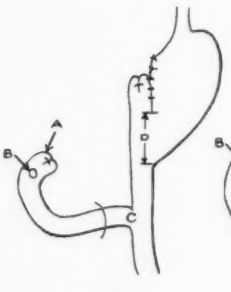

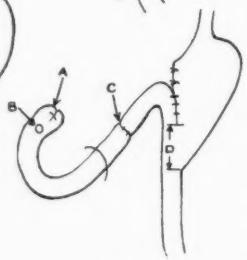

Fig. 20.

Fig. 22.

Fig. 19. *A*, Duodenal ulcer; *B*, gastro-enterostomy stoma; *C*, recurrent gastro-jejunal ulcer; *D*, papilla; *E*, line of resection of duodenum; *F*, line of resection of stomach; *G-H*, resection of anastomosis loop.

Fig. 20. *A*, Duodenal stump; *B*, papilla; *C*, end-to-side anastomosis of jejunum; *D*, typical end-to-side anastomosis lower half of stomach to jejunum.

Fig. 21. *A*, Duodenal stump; *B*, papilla; *C*, recurrent gastro-jejunal ulcer; *D*, line of resection of upper jejunal loop; *E*, line of resection of lower jejunal loop; *F*, line of resection of stomach; and *D*, *E*, *F*, resected stomach, anastomosis, and jejunum.

Fig. 22. *A*, Duodenal stump; *B*, papilla; *C*, end-to-end anastomosis of jejunum; *D*, typical end-to-side anastomosis, lower half of stomach to jejunum.

freedom from symptoms has continued now over a period of 9 years.

If in these 2 cases the so called predisposition to ulcer had been the cause of the repeated relapse, surely the last resection would not have brought about permanent healing. In the first resection for the gastrojejunal ulcer too little of the stomach was removed (half of the dilated stomach had been left behind) so that a marked hyperacidity continued, but in the last resection so much of the stomach was removed that the gastric contents were anacid and therefore when the gastric contents touched the jejunal loop lying above the entero-anastomosis where there is no bile or pancreatic secretion to act as a neutralizer, no harm came to the loop due to the anacidity. Had these contents been acid, there is no question but that another ulcer would have formed. That is undoubtedly the reason both patients have remained healed in spite of the Y anastomosis which in most cases of gastrojejunal ulcer gives a very poor permanent result. In our material 22 such anastomoses show 8 recurrences (Figs. 20 and 21).

Much has been written about the "surgically incurable ulcer." From the material of the Hochenegg Clinic, Mandl cites cases in which three or four operations have been done without affecting a cure but this does not prove that the condition was incurable because an extensive radical operation had not been done in these cases. One of the cases cited as being surgically incurable after three operations without permanent healing has been symptom free for 10 years following a fourth operation—the typical, radical removal of two-thirds of the stomach—done in this clinic.

In these cases of recurring ulcer, if one removes a sufficiently large portion of the stomach, extends the resection to the typical points as described in this paper, instead of making a Y anastomosis, unites the jejunum end-to-end, and then makes the typical end-to-side anastomosis between the stomach and jejunum distally to the circular suture of the jejunum, he will succeed in making the patient symptom free as proved by our own experience (Fig. 22).

Considerable has been written, notably by von Haberer, against extensive stomach resections because of the reduced size of the remaining stomach. The objection advanced is that a patient with a stomach so reduced in size cannot eat a full meal without having palpitation of the heart, dyspnœa, fullness, nausea, etc. It is possible that this may occur in the first few weeks following operation but these phenomena will disappear at once if the patient will lie down for 5 to 10 minutes after eating. After 2 to 3 months the patients are able to eat meals of normal size without any discomfort. Prior to this time it is perhaps better for the patient if he eats smaller meals at shorter intervals, for example, every 2 hours. The symptoms attributed to the reduced size of the stomach disappear, because the jejunal loop used in the anastomosis gradually dilates, sometimes even to the size of an arm and to as much as 50 centimeters in length, but not because of any stretching of the stomach stump. This we have seen in cases which have been re-operated upon later for other conditions and the stomach investigated. On one particular instance, the patient died of a sarcoma of the ileum 9 years after a stomach resection. Autopsy showed a

tremendous dilatation of the jejunum without any adhesions.

The discomfort from a stomach reduced in size would surely persist if the intestine were not able to expand. As an illustration, in the Billroth I type of operation or the von Haberer modification where the duodenum is embedded in adhesions and partly retroperitoneal, the stomach cannot dilate itself to such a degree as the perfectly free and mobile jejunum. The symptoms can also persist in a case in which numerous adhesions in the afferent loop, subsequent to local peritonitis especially after repeated operations, hinder the evacuation of the jejunal loop.

In our material, we have encountered complaints due to a reduction in size of the stomach more frequently after the Billroth I type of operation or the von Haberer modification (20 per cent of cases). Although in these methods much less stomach is removed, still the duodenum cannot dilate in like manner, as the jejunum does in the typical end-to-side stomach anastomosis. In the latter type of operation only 5 per cent of cases have any symptoms which might be attributed to the reduced size of the stomach. In none of the cases, however, were the symptoms severe as all were able to work and were pleased in that they were free from their former pain and that it was unnecessary for them to live on a diet. Only when the patients were pointedly asked if it were possible for them to eat large meals without discomfort did some mention that it was not possible; otherwise it would probably have passed entirely unnoticed.

If there exists any definite sequelæ secondary to the extensive resection it has not been found here. It has been mentioned in literature that these patients suffer from a chronic diarrhœa, the inciting cause being the changed physiology of the stomach following the extensive resection. This we have seen in only 2 cases, and in these cases only when certain foods were eaten did symptoms occur.

The occurrence of pernicious anæmia following extensive resection has also been mentioned in the literature but in our material there has been only one such case. This occurred in a man 55 years of age in whom an extensive gastric resection was done while the patient was in a stage of severe anæmia due to repeated hæmorrhages from a duodenal ulcer. The blood picture was: erythrocytes, 700,000; leucocytes, 10,000; hæmoglobin, 30 per cent. Two years later this man was seen on a medical ward, suffering again from repeated hæmorrhages and a diagnosis of recurrent gastrojejunal ulcer was made. At operation no ulcer was found but there were multiple small angiomata in the jejunum. This patient died one month later and the pathologist made a diagnosis of pernicious anæmia from the findings in the bone marrow but which was not concurred in by the internist staff because of the blood picture and the clinical symptoms. If it should be shown some time later that an extensive stomach resection played any part as an etiological factor in the production of a pernicious anæmia, then surely we would be compelled to abandon this method for a less extensive resection even at the risk of a higher percentage of recurrent gastrojejunal ulcer. However, in a large number of resections, we have as yet to meet this experience.

SUMMARY AND CONCLUSIONS

1. The resection of an ulcer of the anterior wall of the duodenum is technically neither difficult nor dangerous and therefore can be performed by surgeons of more limited experience.

2. The resection of a duodenal ulcer penetrating into the pancreas is more dangerous because of the possibility of injury to the pancreas or the accessory pancreatic duct causing an acute pancreatitis, but this danger is less if the ulcer is not excised from the pancreas like a malignant tumor. Instead it is far better to detach the margin of the duodenum from the floor of the ulcer and leave the latter *in situ*. In all of these cases drainage is absolutely essential. If the penetrating ulcer extends far out toward the papilla or if the common bile duct cannot be isolated from the callus infiltration of the ulcer then it is best to do the resection for exclusion. In such a case the pylorus should be removed only if the first part of the duodenum is free so that a safe and sure closure of the duodenum can be made.

3. In order to obtain satisfactory permanent results, resection of the stomach on the lesser curvature must be made in the vicinity of the cardia where the left gastric artery leaves the cœliac trunk and approaches the stomach. On the greater curvature it must be made a hand's breadth to the left of the middle point of the curvature so that in the case of a normal sized stomach two-thirds is removed and in a highly dilated stomach three-fourths is removed. At any rate only the cardial third of the stomach must be left.

4. The most reliable anastomosis is the Hofmeister-Finsterer modification of the Billroth II method in which all the drawbacks of the original method are eliminated and retrograde filling is prevented. An entero-anastomosis between the pars ascendens duodeni and the jejunal loop will

always overcome retrograde filling but this anastomosis should be avoided as it predisposes to a gastrojejunal ulcer above the anastomosis, if the gastric contents are acid.

5. Insufficiency of the suture line is avoided in a carefully made three layer suture and because in the Hofmeister-Finsterer operation the freely movable jejunum is never under tension and therefore there is no pull on the suture line.

6. The Billroth I method and also von Haberer's modification of it does not adapt itself well to an extensive resection without danger of suture insufficiency due to tension, and if the resection is not extensive then there is the danger of a recurring ulcer. With the Billroth I method in a case in which there is a narrow duodenum, in spite of a careful suture, a stenosis is possible and therefore this operation should be done only when there is a wide and freely movable duodenum.

7. The mortality in gastric resections can be held low even in unselected cases by avoiding ether narcosis and by careful after-treatment. In the past 10 years the mortality in 566 resections for duodenal ulcer has been 3.1 per cent; in the typical end-to-side anastomosis or Hofmeister-Finsterer modification of the Billroth II, 2.3 per cent; in the Billroth I or von Haberer modification of it, 5.8 per cent; in the resection for exclusion, leaving the pylorus *in situ*, 2.1 per cent; in the same operation but removing the pylorus, 14.7 per cent. The high mortality of the latter method can be much reduced by adopting routine drainage.

8. The permanent end-results are due to the extensiveness of the resection; therefore, they are equal in result in the resection for exclusion even if the pylorus is left. In duodenal resection 93.4 per cent of healed cases compares favorably with 90 per cent in the resection for exclusion. Therefore, in non-resectable ulcers of the duodenum the resection for exclusion should be preferred to the simple gastro-enterostomy in which only from 40 to 60 per cent of cases are free from symptoms after operation.

9. Relapse of the duodenal ulcer or recurrence of a gastrojejunal ulcer is due to an insufficient resection but can be cured by a re-operation which must be extensive. The Y shaped anastomosis should be avoided, however, because of poor results.

10. The term "surgically incurable ulcer" is a misnomer because in all cases of recurrent gastrojejunal ulcer operated upon radically at this clinic, permanent healing has been obtained.

FROM THE SURGICAL CLINIC OF THE BENEFICENCIA PORTUGUESA

DIAGNOSIS AND TREATMENT OF ACUTE INTESTINAL OBSTRUCTION

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IN the presence of an obstruction to the passage of matter through the intestinal tract giving rise to acute symptoms, we must endeavor to determine, first, whether the obstruction is a dynamic (spasmodic or paralytic) or a mechanical one, which may be caused by the accumulation of compact matter, by volvulus, by atresia of an intestinal segment, by adhesions, by stenosis, by intrinsic or extrinsic tumors, by strangulation of intestinal loops in any one of the abdominal orifices (internal, external, normal or pathological), by invagination, or other such conditions.

The causes of dynamic ileus are so numerous that we may say that any traumatism or pathological state capable of disturbing the nervous system deeply can produce it. Crushing of the limbs, traumatism of the brain or spinal cord, twisting of the pedicle of abdominal organs or tumors, prolonged handling of the intestine during operations, disease of the nervous system, gastrointestinal intoxication, renal or hepatic colics, peritonitis by mere irritation or infectious (perforation or inflammation of abdominal organs), syphilitic infection, and some poisoning (lead, curare, timbó, etc.) may paralyze or cause spasms of the intestine sufficiently powerful to interfere with the course of the fæcal matter and gases.

To make a differential diagnosis between dynamic and mechanical obstruction, we must at first secure an accurate anamnesis, letting the patient speak in his own words, never correcting his expressions, keeping him under observation, if possible, for hours, examining at short intervals, and utilizing such therapeutic tests as do no harm to him. Through the anamnesis we may secure information about any difficulties preceding the acute onset and this information will help us in determining whether the ileus is of a dynamic or mechanical nature. Through such information we may discover habits and morbid conditions capable of causing stasis. Though there be no atresia of the intestine, we may discover a local lesion that by its development can produce obstruction. Finally, such information may reveal that previous operations have been performed and that there are now present adhesions or stenoses.

The diagnosis of ileus is so complex that in most cases one examination alone is not sufficient. It is necessary to observe the patient for as long a period as the circumstances permit and to repeat the examination combined or not with the therapeutic test.

We begin by observing the facies, respiration, pulse, condition of the heart, sweating, temperature (general and local of the abdominal wall and the extremities), and diuresis; by noting the mechanism, quantity, nature and frequency of vomiting; by noting the seat and character of the spontaneous pains; by observing the abdomen, noticing the volume, form, movements and the modification of the cutaneous blood supply; by palpating to determine tension, muscular defense of abdominal wall, peristaltic movements, dilatation of intestinal loops, the presence of tumors or inflammatory impastation, and the increased sensitiveness of the abdominal regions; by percussion to discover tympanites (localizing it if possible) and to determine whether the normal areas of dullness have disappeared; by auscultation to perceive borborygmi and arterial murmurs (I have seen an aneurism of the superior mesenteric artery cause obstruction); and, finally, when indicated, we resort to the therapeutic test. This test consists in giving hypodermically morphine, atropine, pituitrin, etc., in giving enemas, and in using locally heat or cold, according to the general temperature.

The latest advances in roentgenography make it possible, in almost all the cases, to obtain data to confirm the diagnosis.

Some surgeons consider it a crime to give morphine in the presence of an intestinal obstruction. Is this right? Certainly, if the patient is intoxicated and has a low blood pressure. However, if collapse is caused by violent pain or the intestinal paralysis is caused by a renal or hepatic colic, morphine is unquestionably indicated.

Differential diagnosis between dynamic and mechanical ileus is summarized in Table I.

If we decide that we are dealing with a mechanical ileus, it is of great advantage to know the site of the obstruction, for then the operation becomes easier since, without loss of precious time, we may succeed if we bear in mind the anamnesis and make a scrupulous analysis of the symptoms. Experience teaches us that the fatal outcome and the

TABLE I.—DIFFERENTIAL DIAGNOSIS

Dynamic Ileus	Mechanical Ileus
Anamnesis	
Previous existence of a nervous condition that may cause spasm or intestinal paralysis. Severe pain sufficient to cause a deep alteration of the nervous function. Traumatism of the nervous centers. Infectious diseases, such as peritonitis, meningitis, pancreatitis, appendicitis, etc. Intoxication and poisoning (lead, curare, timbó, etc.). Absence of any previous and local lesion that might cause mechanical obstruction.	Constipation or diarrhœa, associated with tympanism and local pain. Existence of a lesion that, by its evolution, may cause obstruction. Previous existence of hernia or calculous cholecystitis. Swallowing of foreign bodies that may obstruct the intestine.
Facies	
Depending on the disease that caused the obstruction; abdominal in generalized peritonitis, twisting of pedicles, etc., and generally normal in local peritonitis without severe pain, salpyngitis and appendicitis without great repercussion on the peritoneum, etc.	As a rule normal during the first 48 hours and altered after this time except in high obstruction of the small gut, strangulation, and peritonitis as an initial complication when the facies is soon altered. In rare cases of low obstruction we may observe a composed facies for 7 or more days.
Pulse	
The same as in the disease that caused the ileus. A low tension, without general peritonitis, intoxication, or violent pain, is an exceptional condition.	If there is no strangulation, volvulus, or other lesion causing a deep alteration of the nervous system, the pulse is normal or almost normal and of good tension, but as the infection progresses, the pulse becomes rapid and of low tension.
General Temperature	
The same as in the disease that caused the ileus.	Normal at first. It rises progressively as the intoxication increases. When peritonitis is a complication, the temperature is high or low according to the case.
Local Temperature	
Is dependent on the disease that caused the ileus.	Normal as a rule.
Vomiting	
Uncommon but frequent and resistant to treatment when there is peritonitis. Never fæcaloid, if there is no peritonitis.	The frequency and type depending on the height of the obstruction.
Tympanism	
Permanent or not, it is found in all kinds of obstruction. The presence of gas in the peritoneal cavity is rather a sign of perforation of the stomach or the intestine.	Always present. Increases progressively as time passes and decreases only by belching.
Abdominal Pain	
Absent, spontaneous or provoked, local or general, according to the disease that caused the ileus.	Pain only during contraction of the intestine to overcome the obstacle or when peritonitis complicates the obstruction.
Respiration	
Varying according to the disease that caused the ileus.	If there is no severe pain at first normal; in peritonitis or after great distention of the abdomen breathing becomes thoracic, superficial and frequent.
Peristalsis	
Increased in spasmodic ileus and diminished or abolished in the paralytic type.	Always increased and associated with borborygmus audible at a distance; decreased or absent when the ileus is complicated with peritonitis or the disease is in its last period.
Shape of the Abdomen	
More or less distended according to circumstances.	The abdominal wall is uniformly distended; but the presence of greatly distended loops or tumors may cause protrusions.
Diuresis	
If the disease that caused the ileus does not present especial characteristics, diuresis is in inverse ratio to the increasing intoxication and the frequency of attacks of vomiting.	Grows less and less, if the obstruction is not removed; the urine becomes concentrated and nephritis appears.
Permeability of the Intestine	
Restored when the disease that caused the ileus is cured.	Restored when obstruction is removed.

severity of the symptoms vary with the distance of the lesion from the pylorus, that is, the nearer the lesion is to the pylorus the more rapidly fatal is the outcome and the more violent the symptoms. Experience also teaches us that the obstruction is probably located at the site of some lesion which causes an obstruction as it develops.

Therefore, in obstruction of the colons, except in cases of strangulation and volvulus, the progress of the disease is slower and the symptoms at first much less violent than in obstruction of the small intestine; the abdominal distention increases little by little; percussion reveals distention of the cæcum, and by auscultation it is noted that the murmur of the gaseous waves comes from the median line in the direction of the right iliac fossa and there disappears.

If the obstruction is located in the descending colon, sigmoid flexure, or the rectum, we discover that the shape of the fæcal matter has been modified and that the patient has had attacks of diarrhœa. In such cases enemas are expelled as soon as they are introduced.

If the obstruction affects the small intestine, the general condition of the patient becomes worse, the circulatory apparatus becomes insufficient, peristalsis increases, and tympanism and intoxication develop more rapidly. From the onset the colics are more intense and the waves formed by the distended loops more perceptible. Distention of the abdomen, though less extensive than when the colons are obstructed, appears sooner.

Fig. 1. Roentgenogram showing distention of the intestine.

TREATMENT

In treating a patient with intestinal obstruction it is essential first to improve his general condition. Though he is seen at the very onset, if he is in collapse, we must try to build up his strength before operating. To accomplish this, hypertonic salt solution is injected to restore the fluid content of the tissues, morphine is administered to relieve pain, and heart stimulants are given to maintain the myocardial tonus.

If, however, the disease is in its last stages, that is, if the symptoms of stercoræmia are established, the treatment must then be directed against the intestinal stasis, the insufficiency of the hepatic cells, the tendency to anuria, and the peritonitis that is frequently present at this time.

Stasis is eliminated by establishing an artificial anus. This operation is performed under local anæsthesia and the anus is made on the small intestine, appendix, the cæcum or colon, or, if impossible to choose, the easier obtainable dilated loop is used. To restore the function in the hepatic cells and to correct the tendency to anuria, hypertonic serum—glucose and insulin (250 cubic centimeters of serum glucose and 10 units of insulin per dose)—is injected and nourishing liquids are given in small amounts.

When glucose and insulin are used, it is necessary from time to time to analyze the urine and blood; if glucose is found in the urine, the glucose solution is discontinued and hypertonic salt solution is substituted. If the percentage of glucose in the blood is below normal, the insulin is discontinued and glucose solution is used. Lavage of the stomach and intestine with physiologic serum through a tube introduced through the mouth or through the abdominal fistula helps to lessen the intoxication. Heart stimulants and the local application of heat or cold, depending on the general temperature, are advantageous in peritonitis; and if the condition is infectious, sera and vaccines are indicated. Should the peritonitis be so advanced as to produce pus, it is necessary to open and drain the purulent collections.

In these extreme cases, it is possible to arrive at a more or less definite diagnosis. We must endeavor to determine whether the ileus is a mechanical or dynamic one. If dynamic, the treatment is principally that for the affection which has caused the ileus. If there is present a peritonitis, inflammation of the abdominal organs, twisting of the pedicle of tumors or organs, violent colics (hepatic, renal, ovarian, etc.), thrombosis of mesenteric vessels, nervous disease, etc., the treatment is that for these affections, together with enemas and drugs to relieve the spasm or to restore the peristalsis when there is no peritonitis. In mere paralytic ileus, electricity is a good stimulant.

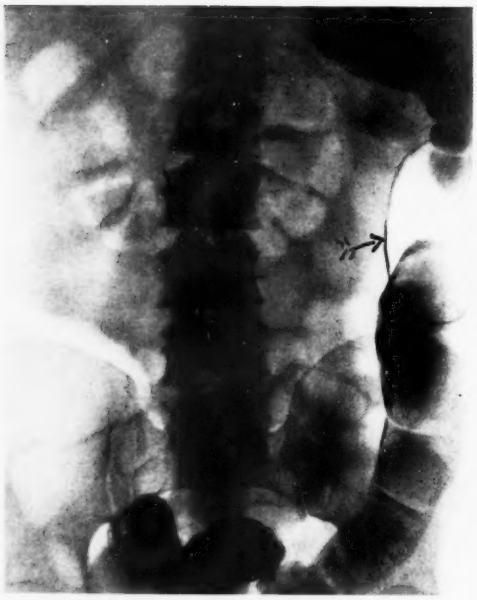

Fig. 2. Roentgenogram made after enema of citobarium. Obstruction is seen close to splenic angle of colon indicated by arrow.

Generally speaking, in dynamic ileus surgical intervention is indicated only when the condition that caused the ileus calls for operation or when intoxication is so advanced that drainage of the intestine is an absolute necessity.

A brief report of 4 cases from my clinic may be of interest in a discussion of this subject.

A man of strong constitution, aged 40 years, entered the hospital of the Beneficencia Portuguesa, complaining of pain in the upper part of the abdomen and frequent attacks of vomiting. The vomitus was acid and was sometimes stained with bile. He was unable to retain anything in the stomach. Antiemetic and sedative drugs produced no alteration in his condition. When I saw him in consultation with his assistant surgeon, he was deeply depressed and had abdominal facies; the pulse was weak and frequent though serum and heart stimulants were liberally given. Pain and vomiting came at short intervals. The abdomen was not distended and there was no pain or muscular rigidity on palpation. Because the medical treatment had had no effect, laparotomy was done. There was no peritonitis but there was found a cord-like contracture extending about 20 centimeters in the highest part of the jejunum. In this area peristaltic movements were seen. The intoxication increased and the patient died the next morning.

The second case may be considered as one of traumatic paralysis. A man operated upon for a strangulated inguinal hernia, presented the morning after operation, a very distended abdomen with a point, close to the umbilicus, sensitive to pressure. No fæces or gas was passed by anus. Paregoric elixir was given by mouth and a warm cataplasm was applied to the anterior abdominal wall. Twenty four hours later, the patient passed fæces and gas.

Another man, aged 32 years, of good constitution, was operated upon for a chronic appendicitis, which had presented the characteristic colic and nausea syndrome. Two days after operation, the patient presented a marked gaseous distention of the abdomen. He had no fever or pain, but he did have difficulty in breathing and an accelerated pulse, though of good volume. He looked like one of those toads that swell by swallowing air. Pituitrin was given and gas was expelled. However, the abdomen soon became swollen again. As the Wassermann was found to be positive, we resorted to intravenous injections of oxycyanide of mercury. The tympanism disappeared. This was a case of dynamic ileus caused by syphilitic infection.

The fourth case presented a peculiar obstruction which had lasted for 5 days and was caused by renal colic. A manufacturer, aged 62 years, constipated and with lightly icteric skin, became ill, February 17, 1930, with spontaneous pain in the left loin and the same side of the hypogastrium. He passed urine frequently but in small quantities. The specific gravity was 1030. No sugar or albumin was found in the urine. He was given a sedative and, as it produced no relief, sedol was injected. The pain decreased but though the abdomen began to swell it was not tense. An enema brought some fæces but had no effect on the tympanism. The morning temperature was 37 degrees C. and the evening temperature 37.5 to 38. No effect was obtained from a dose of magnesia and nujol. The gas did not pass through the anus, but was expelled by mouth. The patient at first vomited and was salivated. When I saw him in consultation with his physician on the morning of the 22d, he had a temperature of 37 degrees C. and a full pulse of 80. The abdomen remained distended and was sensitive to palpation on the left side. By percussion we perceived that the cæcum and right angle of the colon were distended with gas. The small intestine was less dilated than the colon.

The peristaltic contractions were at times associated with pain and during such contractions a murmur of shaken liquids and gas could be heard. The gaseous waves were in the direction of the cæcum and there they were lost. We had the impression that the obstruction might be in the left colonic angle. There was no dyspnœa, but breathing was somewhat accelerated. We advised the following enema: infusum chamomile, 1 liter; castor oil, 80 grams; essence of turpentine, 4 grams; and an egg yolk to make an emulsion. Twenty minutes after the enema, the patient emitted gas, liquid fæces, and mucus stained with blood. The distention of the abdomen disappeared.

Radiographic examination revealed in the first film, distention of the intestine, but no calculus in the urinary tract. After an enema of citobarium, we took a second film in which we could see an obstruction close to the splenic angle of the colon (see arrow Fig. 2). The opaque substance had reached the ascending colon. A third film (Fig. 3) with the anterior abdominal wall of the patient on the table, showed that the obstruction was a block of fæcal matter (see arrow). Soon after the examination, patient passed the enema and during the night he had abundant bowel movements. The urine was condensed, and in suspension showed crystals of uric acid. The abdominal symptoms disappeared but the pain remained in the left loin. Relief was secured by hot baths and allonal.

If we are dealing with a mechanical obstruction and the enemas fail to restore the permeability of the intestine, we must resort to laparotomy as soon as possible.

When the exact position of the obstacle is known the incision should be placed over it; if the position is not known, it is better to cut the anterior abdominal wall in the median line, with the umbilicus as a center. When the latter incision is used it must be long enough to permit the inspection and handling of any part of the intestine. First, the abdominal cavity is inspected. An abnormal amount of liquid and a hyperæmic peritoneum indicate peritonitis; if the liquid contains bile, urine, fæces, or alimentary particles, the gall bladder, urinary bladder, intestine, or the stomach is perforated. Blood stained liquid is a sign of stasis and pure blood indicates an internal hæmorrhage. Venous stasis and necrosis of the intestinal wall indicates an obturation of the mesenteric vessels. In pancreatisis, coagulation of the fat in the mesenterium and epiploon is found.

If the stomach is distended, the obstacle is situated on the pylorus or duodenum. If one portion of the small intestine is distended and the other collapsed, the obstruction is found between them. A dilated cæcum is a sign of obstruction of the large intestine.

To reach the obstructing lesion it is preferable to follow the empty loops and to avoid dislodging the dilated ones which are always difficult to replace. When the obstruction is caused by gall stones, foreign bodies, fæcal lumps, or benign pedunculated neoplasm, incision, removal of the obstacle, and suture are sufficient treatment. If, after dissecting bands or adhesions, the surface of the loop is stripped of peritoneum, it is better to do a resection. Resection is also indicated in the presence of irreducible invagination, malignant tumors, volvulus, deep and diffuse tuberculosis, syphilitic gumma, etc. Obturation of the mesenteric vessels is the worst condition that the surgeon encounters for he never knows the exact extent of the disease and has to rely somewhat on luck in doing the resection. If the local or the general conditions do not permit a radical operation, and intestinal fistula may be placed above the obstruction.

After the obstacle is removed the cavity, if soiled, is cleaned with wet gauze and the wound is closed with or without drainage, according to the condition of the peritoneum. Eventration is done only when it is impossible to do otherwise. If marked gaseous distention of the intestine hinders the reduction of the intestinal loops, our method of choice is to remove the gas and liquids by means of needles and an aspirator. An incision of one or more loops to empty the gut of fæces is a very hazardous procedure if the peritoneal cavity is widely open. It is preferable to close the peritoneal wound and leave exposed a portion of the loop which has been selected to open immediately or some hours after operation. The emptying and washing out of the intestine is done through the artificial anus, if necessary, with the aid of a catheter.

Fig. 3. Roentgenogram with patient's anterior abdominal wall on table. Obstruction indicated by arrow.

Should the general condition of the patient make impossible radical intervention, an artificial anus must be made to enable the surgeon to wait for a better occasion.

Dehydration of the tissues is an ordinary occurrence in patients with intestinal obstruction. It is caused by vomiting and the fact that it is impossible for the patients to retain liquids. Hepatic, renal, and nerve function is low for the same reason and because toxins are retained in the plasm. Under these circumstances hypertonic salt solution is given to check the loss of liquid, glucose solution and insulin are injected to restore the hepatic function and to make more nearly normal the plasma contents; and heart tonics are given to stimulate the myocardium.

Finally, the washing out of the stomach and large intestine is very helpful in removing the intoxicating substances.

SUMMARY

1. An acute intestinal obstruction may be dynamic or mechanical.

2. A careful anamnesis, a meticulous examination and due consideration of all the symptoms enable us, in most cases, to determine the type of ileus in a given case.

3. The operation is easier and associated with less danger if we know the exact site of the obstruction. When the pain and tympanism have become localized, when the previous history of the disease is obtainable, when the symptoms are appreciated, and when local appearances are characteristic, it is then usually possible to determine the exact location of the obstruction.

4. With regard to treatment, two conditions demand urgent measures: the initial collapse and the late intoxication, associated or not with peritonitis caused by infection through the intestinal wall. In the first, it is necessary to increase the strength of the patient by means of medical agents, before operation is done; in the second, we must combat the intoxication and relieve stasis, an artificial anus being made with the aid of local anæsthesia. Radical operation must be postponed.

5. Even in these urgent cases, we have sufficient time to make a diagnosis before operating.

6. If we have any doubt about the recidivation of the obstruction, it is preferable to resect the affected part of the intestine.

7. As we have to do with dehydrated and toxic patients, it is indispensable to have at our reach hypertonic salt solution, glucose solution, and insulin.

THE TREATMENT OF PELVIC CELLULITIS

Surgical Drainage of Parametric Exudates

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THE management of pelvic infections which result in parametric cellulitis is often a most perplexing problem. The occurrence of a parametric exudate enforces upon the patient a long and serious illness, which, when treated by an expectant regimen, gives slow and often disappointing results. Such infections are most frequently seen as a sequel to postpartum infection but occur as a complication of many pelvic operations also. In selected cases, surgical drainage apparently offers striking, immediate relief from symptoms and a shortened period of morbidity. We wish to give the clinical results of a series of 10 cases in which broad ligament infections were drained by the method proposed by Cullen.

Puerperal infection, recognized and unmistakably described by Hippocrates, is still a dangerously prevalent disease of parturient women. Although it has been recognized since Semmelweiss and Holmes that the hand of the accoucheur is the most frequent source of infections, the incidence of postpartum infection is alarmingly high, especially in this country. Pelvic cellulitis is one of the graver manifestations of puerperal infection, represents commonly extension of an infection of the endometrium, and is a reaction of the pelvic connective tissue to bacterial invasion. The extension of infection from the endometrium or from lacerations in the cervix occurs through the lymphatics leading to those nodes situated principally in the broad ligament regions. Many varieties of organisms have been associated with puerperal fever, principally types of streptococcus, staphylococcus, bacillus coli communis, and many varieties of saprophytic cocci and bacilli, both aerobic and anaerobic. Sterile cultures result in a surprising number of cases and smears show few organisms in some cases. Williams, having taken cultures from the uterine lochia of 324 cases presumably having postpartum endometritis, found 68 which were sterile.

The frequency of broad ligament exudations is difficult accurately to estimate. Many of the milder varieties of these cases escape unrecognized, and the patient who has a postpartum febrile reaction and develops a small exudation in the cellular tissue in the broad ligament, which never becomes very large or is obviously an abscess, is usually not diagnosed. Such mild cases resolve spontaneously after an unexplained short febrile course.

Puerperal infection is frequently complicated by femoral phlegmasia alba dolens but our experience leads us to agree with Polak, who states that pelvic cellulitis, acute or chronic, is, next to endometritis, the most frequent pathological lesion found in puerperal infection.

The extension of infection from the uterus or from tears to the cervix produces, as a rule, a fairly typical clinical picture. There is a preliminary elevation of temperature which may or may not subside and ends after a day or two. Several days later there is usually a chill, a high elevation of temperature, and abdominal pain either on one or both sides. Either a vaginal or an abdominal examination may reveal a tender spot and a palpable mass in the broad ligament. Extension may occur anteriorly dissecting the peritoneum from the anterior portion of the bony pelvis and the abdominal wall, or less often it may extend backward toward the retroperitoneal region. The clinical course of these cases is usually protracted, and there are often repeated chills. There is daily elevation of temperature, an accelerated pulse, and elevation of the white count. Certain of our cases, however, had slight temperature, practically no leucocytosis, and complained solely of abdominal pain. The exudate is hard and fixed and it is often difficult to make a diagnosis of abscess even when the interior of the mass may be filled with pus. The febrile reaction may continue for weeks before resolution takes place, if the drainage is not instituted. Septicæmia and the spread of the infection to the peritoneum are the most serious dangers which threaten, and against which the surgeon must be on his guard. Repeated pelvic examinations should be avoided.

The patient should be placed in the Fowler position and made comfortable with sedatives. We have employed, with apparent good effect, external heat as suggested by Polak and Gellhorn, in the form of moist abdominal stupes frequently changed. The wisdom of drainage of these cases is questioned by many unless there is frank pointing of an abscess. Polak states that only 6 to 7 per cent of these parametric exudates suppurate and that the vast majority end in resolution. Observation of these cases has led us to employ

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Fig. 1. Diagrammatic view of the extraperitoneal approach to the infected area in the broad ligament region as advocated by Cullen. The insert shows the site of the inguinal incision.

the method suggested by Cullen in 1917, i.e., of incision just above Poupart's ligament and drainage of the exudate from between the folds of the broad ligament without opening of the peritoneum. This procedure we have employed on the following indications: (1) when there is definite fluctuation of the parametric mass, (2) when there is a solid exudate of considerable size suggesting the possibility of there being a collection of pus within it. If the patient is running a febrile course and is very ill, especially if the blood sedimentation time is low, we believe incision and drainage to be desirable unless the inflammatory mass is quite small. We have not, as a rule, operated upon patients until they have been under observation from 5 to 6 days, unless there has been outspoken fluctuation and obvious pointing of a parametric abscess in a given direction.

The question of draining a cellulitis in the pelvis presents the same problems from a surgical standpoint that cellulitis does anywhere else. As every operator is aware, incision of any inflammatory mass occasionally precipitates a septicæmia. The beneficial results of incision and drainage of infection in this area, however, in our experience far exceed any harmful effect. The time for intervention in the individual case is a matter of clinical judgment. Patients with large parametric exudates containing as much as 400 to 600 cubic centimeters of pus are sometimes almost afebrile yet have tedious and painful convalescences if one does not operate until he is certain of fluctuation. De Lee, Williams, and others advise drainage of frank abscesses but many times the patient may waste away and die of exhaustion before an abscess points. Early drainage of indurated areas will often abort them and foci which have persisted for months will often clear up rapidly after incision. From the standpoint of safety, as emphasized by Cullen, the extraperitoneal approach is greatly preferable to transperitoneal drainage inasmuch as these abscesses may contain virulent streptococci, which are capable of producing a rapidly fatal peritonitis. Drainage through the cul-de-sac of Douglas or the lateral fornices of the vagina is undesirable because there is danger of injury to ureters, uterine vessels, or contamination of the peritoneal cavity.

OPERATION

After a definite diagnosis of parametric cellulitis is made, especially if there is fluctuation or a

suspicion of fluctuation, incision is made about an inch above and parallel to Poupart's ligament (Fig. 1). The parametric masses often feel continuous with the uterus, extending into the lateral fornices but may be detached from it. They feel, upon vaginal touch, as if they were close to, or almost inside, the anterior abdominal wall in contrast to a tubal or tubovarian mass which is usually definitely posterior to the uterus upon palpation. The external oblique aponeurosis is opened in the line of its fibers and the conjoined tendon is identified. The pulsation of the deep epigastric artery may be made out and by gentle blunt dissection, the cellular tissue under the conjoined tendon and above Poupart's ligament may be thrust back. Lateral and below, the femoral artery can be felt pulsating and a safe margin for the femoral vein which is medial to the femoral artery must be kept in mind. The finger is pushed down close to the wall of the bony pelvis but crooked posteriorly, pointing in a medial direction in order to escape damaging the femoral vessels. Little pressure usually is required and there is practically no bleeding. The mass may be readily felt by the examining finger, pressure being made upon the corresponding lower quadrant of the abdomen with the other hand.

The finger is lateral to the ureter, the deep epigastric artery is above or may be just medial, the femoral vessels are lateral (Fig. 1). When the examining finger touches the inflammatory mass, if the wall is very thin, the finger may be pushed into the mass the wall of which is perforated easily, although the mass appears to be solid. Two drains are placed down through the sinus thus made into the broad ligament region. As frequently happens when opening abscesses, the operator finds that the abscess cavity has been entered before he is aware that it is being perforated. This, however, is of no consequence if his anatomical orientation is exact. A large amount of pus is often evacuated although the abscess wall may have been hard and resistant. A small gush of serum is sometimes all that follows immediately. Drainage usually becomes more profuse in the course of a day or two, and the condition of the patient usually improves markedly. The increase in drainage, of course, is doubtless due to some extent to the tissue reaction to the foreign body, to the trauma of the procedure, and to the introduction of drains into a sinus tract which presupposes infection from without. However, the improvement in the general condition of the patient has, in our experience, almost invariably seemed synchronous with the operative intervention.

Williams states that incision into broad ligament cellulitis with evacuation only of a small amount of serum frequently gives as good results as if large amounts of pus were encountered, as is true in cellulitis in general. The external oblique is closed with interrupted sutures of chromic catgut fairly snugly about the cigarette drains. The drains are moved on the second to third day and are shortened steadily each day. They are usually removed about the sixth to eighth day. The sinus often drains slightly for 2 to 3 weeks.

CASE SUMMARIES

CASE 1. P. R., aged 25, was admitted to the hospital January 10, 1930, and was discharged February 14, 1930. The patient, a colored female, complained of pain in the right side of 5 weeks' duration. While taking an enema she was seized with severe pain in the lower abdomen, became very weak, and fainted. Some vaginal bleeding occurred at this time and she was in bed 5 days before admission. The patient's general health was poor. A fistula *in ano* had been excised several months ago. Otherwise she had had no operations. Patient had had pneumonia in 1919 and thinks she had a neisserian infection 1 year ago. There was intermittent pain in the right side for 2 years. Menses began at the age of 13, were regular, occurring every 28 days, and lasted 3 days. She had a miscarriage 3 years ago. The last menstrual period, December 6, 1929, was normal. Family history was negative. Physical examination revealed a poorly nourished colored girl having some pain. She looked very weak and pale. Chest was negative. There was an ovoid mass the size of a grapefruit lying to the right of the midline extending nearly to the level of the umbilicus. This mass was fluctuant and tender. The cervix was hypertrophied and pushed anteriorly, the uterus was not defined, there was a large mass in the right vault and a smaller mass in the left. The Wassermann was negative. Hæmoglobin was 78 per cent; red blood cells 3,300,000. Bilateral salpingo-oophorectomy, posterior plication, and appendectomy were performed. Convalescence was stormy until the tenth day after operation when the temperature reached 40 degrees. Patient was transfused and in the broad ligament was found an abscess which was drained extraperitoneally. Two cigarette drains were inserted. The course was uneventful after this and the patient was discharged on the twenty-third day after operation. This method of drainage is often valuable for approaching extraperitoneal accumulations of pus in the broad ligament after operations for tubal disease.

CASE 2. A. S., aged 20 years, was admitted to Lakeside Hospital, March 10, 1930, and discharged March 19, 1930. The patient, a white woman, complained of pain in the left side which had been present since December 20, 1929, immediately following delivery of a full term child. Pain had been very severe for a few days before admission. There was profuse leucorrhœa, dysuria, and burning upon urination. On January 23, 1930, when she was in the hospital, a diagnosis of postpartum abscess was made. She was treated expectantly. At this time a diagnosis of epilepsy was made. She was readmitted with the idea of draining the abscess extraperitoneally because she was making no progress. The family history was negative and the past history was unimportant except for eclampsia. Patient is a well developed but small white woman not acutely ill. There was tenderness in the lower left quadrant. Temperature was 38.2 degrees. The perineum was in good condition, the cervix lacerated and hypertrophic, the fundus

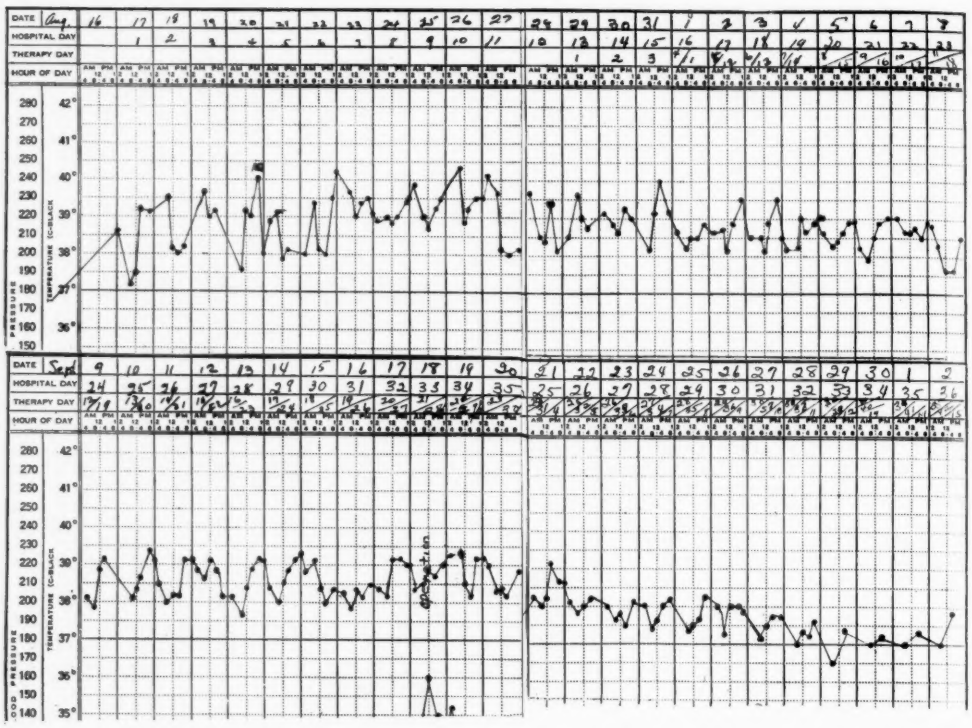

Fig. 2. Case 9. Temperature chart of a typical case of pelvic cellulitis showing the unremitting character of the fever a month prior to operation and prompt defervescence after operation.

anterior but pulled to the right, and there were very tender fluctuant masses in both lateral vaginal vaults. Laboratory findings were negative. On March 11, 1930, drainage of the left broad ligament abscess was done. About 200 cubic centimeters of thin, brownish fluid was obtained, culture of which was negative for 48 hours. A cigarette drain was inserted into the wound in the groin. The temperature never arose beyond 38.5 degrees. The patient was discharged from the hospital on the eighth day after operation and is to return to the dispensary for further observation. The small exudate on the other side cleared up spontaneously.

Case 3. M. R., aged 32 years, was admitted to the hospital August 22, 1929, and discharged September 27, 1929. The patient, a negress, came to the hospital because of pain in the left side since an abortion 1½ months before. A week ago the pain became generalized in the abdomen. She had had fever for the past week with dysuria and frequency. The past history was negative. The last menstrual period was April 20, 1929, and the previous period March 21, 1929. Patient had one child of 7 years and one miscarriage in 1924. She had a spontaneous abortion in July at which time she was about 3 months pregnant. The patient was a dehydrated colored female, fairly well developed and fairly well nourished, whose heart and lungs were negative. The abdomen was spastic and there was tenderness over the entire lower abdomen. Pelvic examination revealed a marital outlet, the cervix small, posterior, fixed, with tenderness on manipulation. Uterus was immovable. There was a large fluctuant mass with tenderness on the right. Laboratory findings revealed a negative urine, white blood corpuscles 13,800; red blood corpuscles 4,000,000; hæmoglobin 80 per cent; Wassermann 4 plus. On admission, the temperature was 38.5 degrees C. The following day an extraperitoneal drainage of an abscess on the right broad ligament was done. Temperature was normal and the patient was comfortable on the fourth day after operation but the sinus continued to drain. Five per cent mercurochrome was instilled into the abscess cavity daily and drainage gradually stopped. She was allowed up and this did not cause elevation of temperature. At the time of discharge, the incision in the right side was surrounded by granulation tissue. There was a small sinus extending into the cavity. The cervix was pulled slightly to the right, the uterus anterior and pulled to the right. There was thickening but no definite mass in the right fornix. Diagnosis: broad ligament abscess, right; syphilis (Wassermann).

Case 4. G. M., aged 22 years, was admitted to the hospital September 28, 1929, and was discharged October 15, 1929. The patient, a married white female, was admitted through the dispensary, with the complaint of lower abdominal pain and foul vaginal discharge. She had an abortion induced on September 2 after one missed period. There was such profuse bleeding that she was taken to another

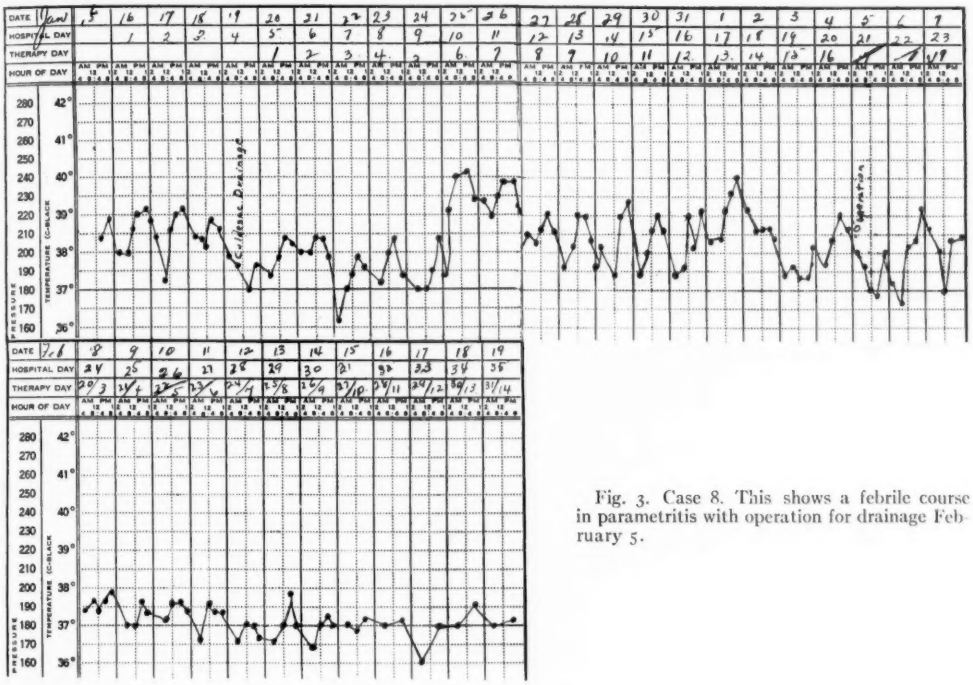

Fig. 3. Case 8. This shows a febrile course in parametritis with operation for drainage February 5.

hospital and kept there for 6 days. Bleeding stopped while there and patient had no fever. A foul smelling vaginal discharge had continued and during the past week she had considerable pain in the lower left quadrant. Patient's general health was good. She had had no serious illnesses, and family history was unimportant. The onset of menses was at 15 years of age and they were regular every 30 days. Patient suffered convulsions at time of periods. She has had no lurinary disturbances, but there has been a yellow vagina discharge for the past 3 years. Patient was a poorly developed and poorly nourished white woman with pallor of the skin and mucous membranes. Heart and lungs were normal. Temperature was normal. Pelvic examination revealed a marital outlet, the cervix in the midline and firm, the uterus slightly enlarged. There was a mass the size of an orange in the left broad ligament region. Hæmoglobin, 58 per cent; white blood corpuscles 34,000; red blood corpuscles 5,000,000. The urine contained a trace of albumin. On October 3, 1929, extraperitoneal drainage of the broad ligament abscess was performed. Thick yellow pus was obtained but there was no growth on the culture. Patient had a mild febrile reaction. Temperature quickly dropped to normal, and the patient was discharged 12 days after operation. Diagnosis: parametric abscess, left.

Case 5. L. W., aged 30 years, was admitted to the hospital December 12, 1928, and was discharged January 22, 1929. The patient entered the hospital with the complaint of sharp pain in the right lower quadrant radiating into the right flank, for the past week. There had been no vomiting at the onset and no dysuria. Illness was associated with considerable discharge. Patient had typhoid and pneumonia in childhood. Menstrual periods began at 14 years of age, were regular every 28 days, lasting 4 days, were associated with severe headaches, backache, and abdominal cramps occurred the day previous to the onset of menstrual flow. Last menstrual period December 8, 1928, previous period November 11, 1928. Patient had had five miscarriages, none of which was self-induced. The patient was a well developed and well nourished colored woman apparently in acute pain. Physical examination was negative except that the abdomen was very tender in the right lower quadrant over McBurney's point and toward the symphysis. A mass with a rounded upper pole extended to the umbilicus. Pelvic examination revealed a marital outlet, the cervix small and in the axis of the vagina. There was a large mass filling the whole right fornix extending downward behind the cervix, associated with extreme tenderness and thought to be continuous with the uterus. On admission white blood cells were 34,200; the red blood cells 4,420,000; hæmoglobin 90 per cent; urine, negative; Wassermann, negative; sedimentation time 20 minutes. The condition of the patient became worse and on December 17, 1928, white blood cell count was 31,000. Extraperitoneal drainage of the broad ligament abscess was done and a very large amount of fluid and pus was obtained. Incision was drained with cigarette drains and the wound continued to drain for a period of about 4 weeks. Pelvic examinations during her stay in the house revealed a large mass about 8 centimeters in diameter, very tender, and continuous with the uterus. Temperature remained normal after the 18th day after operation and the patient was allowed up and around the ward. At the time of discharge the pelvic examination revealed a marital outlet, the cervix small and in the axis, and the uterus enlarged and tender. Abdominal

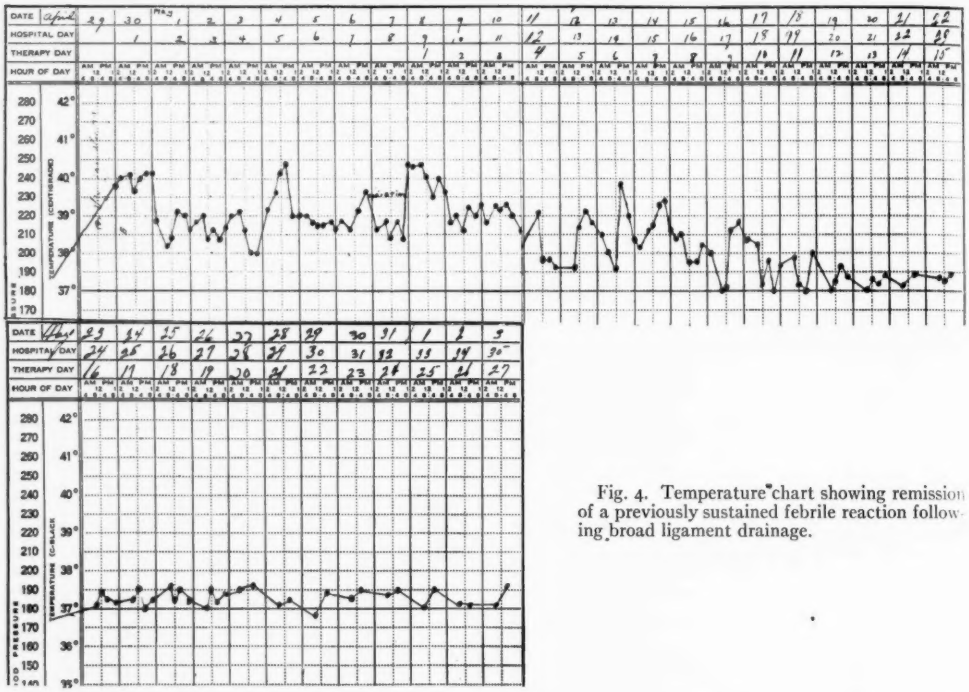

Fig. 4. Temperature chart showing remission of a previously sustained febrile reaction following broad ligament drainage.

palpation revealed no tenderness. White blood cell count was 9,100. Diagnosis: pelvic cellulitis. The patient was discharged on January 22, 1929, in good condition.

CASE 6. I. M., aged 32 years, was admitted to the hospital June 7, 1929, and discharged September 25, 1929. The patient complained of pain in the abdomen, chills, fever, nausea, and vomiting. The patient was 4 months pregnant and on March 30, an induced abortion had been performed. She began to bleed 3 days later and continued to flow for 3 weeks. Ten days after the abortion, she began to have chills and fever and was taken to a hospital where she remained for 3 weeks and was discharged improved. Menstrual periods began at the age of 12 years, were regular every 28 days, lasting 2 to 3 days. The patient has had 2 children and 2 miscarriages. Heart and lungs were negative on examination. There was a board-like rigidity over the entire abdomen with a definite palpable mass in the right lower quadrant. Pelvic examination revealed a marital outlet, the cervix anterior, large bilateral pelvic masses, the one on the left extending above the umbilicus and beyond the midline to the right, filling the entire lower left quadrant. The one on the right was smaller and about the size of an orange. The uterus could not be definitely made out but it was thought to lie posteriorly. The urine examination showed an albumin trace, and pus in clumps. White blood cells numbered 34,000; red blood cells 3,260,000; hæmoglobin 58 per cent. Sedimentation time was 20 minutes. Wassermann was 3 plus. After she entered the hospital the temperature continued to rise and on the fifth day, extraperitoneal incision with drainage of the abscess was done. The temperature fell somewhat and the drains gradually were moved, although the temperature continued to rise, occasionally to 39.5 degrees. On the twenty-fourth day, the sinus was again opened for better drainage, and the temperature started a gradual downward course until the sixty-sixth day when the abscess cavity was again explored. A large amount of pus escaped at each operation. The temperature fell almost to normal. Twelve days following this, a transfusion was given of 500 cubic centimeters. On the one hundred and first day the temperature reached normal to remain there for the first time. Ten days later she was discharged from the hospital. During the stay in the hospital, she was given neosalvarsan at weekly intervals. Improvement was gradual with occasional exacerbations from time of admission to time of discharge. Blood cultures were negative. Cultures from the broad ligament abscess showed a mixed infection, dominantly staphylococcus and colon bacillus. At the time of discharge, the uterus was anterior and somewhat fixed. There was a slight amount of discharge from the incision. Diagnosis: pelvic cellulitis, bilateral, and syphilis (Wassermann).

CASE 7. F. B., aged 36 years, was admitted to the hospital February 4, 1929, and discharged March 12, 1929. The patient was a negress, 36 years of age, I-para, the child being 4 years old. The patient came into the hospital complaining of uterine hæmorrhage for 2 weeks. She had had nausea and vomiting for the past 2 weeks and severe cramp-like pains in the lower abdomen. The patient menstruated normally in January. Past history was negative except for appendectomy and removal of a tubal pregnancy 4 years ago. Family history was negative. The temperature rose rapidly to 40.5 degrees C, declining to a level of 39 degrees C, where it remained for 8 days. Physical examination was essentially negative. Examination on admission revealed

a marital outlet, a normal cervix, and an enlarged and soft uterus. There was an indurated mass 5 to 6 centimeters in diameter, which was hard and firm, non-fluctuant, definitely fixed, and firmly attached to the uterus. A right inguinal incision was made about 1 inch above Poupart's ligament, the external oblique aponeurosis was opened, and the broad ligament was explored. There was a gush of serum, but no frank pus was encountered. Two cigarette drains were inserted under the conjoined tendon. The patient's temperature within the next 3 days declined steadily, and there were in the following 2 weeks, remissions and exacerbations of temperature. Patient's general condition was excellent. She suffered no discomfort. On the fifteenth day after operation, the temperature was normal and only once did she have an elevation thereafter. She was discharged on the twenty-seventh day after operation. However, she had been walking about the ward for 10 days. On admission the laboratory findings had revealed the hæmoglobin to be 85 per cent, the white blood cells to be 25,000. Wassermann was negative, and sedimentation time 17 minutes.

CASE 8. G. F., aged 33 years, was admitted to the hospital January 15, 1929, and discharged February 22, 1929 (Fig. 3). The patient was a white female, I-para, who entered the hospital complaining of severe pain in the back, pain in the lower abdomen and on both sides. She had had nausea, vomiting, chills, and fever for a week. The past history was negative except that the patient had been treated 7 years ago for retroversion. The family history was negative. Physical examination was negative except for a moderate degree of emaciation. Pelvic examination revealed a marital outlet, the cervix pushed far forward under the symphysis. There was a mass posterior which was apparently the fundus uteri adherent to the right side posteriorly. The patient gave no history of abortion or any missed periods. The last period of menstruation was 3 weeks before. The identity of the mass in the cul-de-sac not being clear, it was decided to open the cul-de-sac. About 1 ounce of serosanguineous fluid escaped. No pus was encountered and this opening was sutured. Six days later the patient's temperature rose abruptly with a chill to 40 degrees and fluctuated between 38 and 40 for 10 days, at which time pelvic examination revealed a definite left sided perimetric mass. An inguinal incision was made on the left, a finger pushed the peritoneum back, and a small amount of serum escaped from the peritoneum. No gross pus was seen. The temperature dropped promptly to normal on the third day and never rose again.

CASE 9. M. B., aged 23 years, was admitted to the hospital August 17, 1929, and was discharged October 5, 1929 (Fig. 2). The patient was a married white woman who complained of cramp-like abdominal pain and vaginal bleeding. Three days before entering the hospital, after 3 months of amenorrhœa, she suddenly began to have cramp-like pain and passed blood clots. She had several chills before admission and there was a fetid odor to the discharge. She did not think she had passed a fetus. The patient's general health has been good. There have been frequent attacks of tonsillitis, a tonsillectomy being performed in 1915. There was an extensive skin burn in 1924, acute mastitis in 1926. Family history was unimportant. Menses were regular every 28 days and lasted from 3 to 5 days. She has always had cramp-like pain with menses and considerable leucorrhœal discharge for 4 years. The patient has 2 children and has had two early abortions which were spontaneous, 3 years ago. There was no history to suggest infection following a previous pregnancy. The patient is a small, poorly nourished, white female who appeared to be extremely ill and dehydrated. Temperature was 38.6 degrees. Teeth were carious, heart and lungs normal, there was slight muscular spasm and tenderness throughout the lower abdomen. Pelvic examination revealed a marital outlet, the cervix soft, posterior, and fixed, the fundus enlarged, firm, and deflected to the right. There was marked induration in the cul-de-sac and in the right vault, with bleeding from the cervix. The urine contained a trace of albumin and a few granular casts. Hæmoglobin was 90 per cent; red blood cells 8,150,000; white blood cells 7,940. The patient was treated palliatively, with rest in Fowler's position, hot abdominal stupes, pituitrin, and ergot. Temperature ran a high septic course for 2 weeks. Pelvic examinations revealed what was interpreted as an extensive cellulitis in the left broad ligament. By September 18, an abscess had formed and this was drained extraperitoneally. No cultures were taken of the pus obtained. Following incision, the condition of the patient improved rapidly. The temperature of the patient gradually dropped to normal and the discharge from the wound subsided gradually. Diagnosis: infected abortion, acute endometritis and parametritis, and abscess of the left parametrium.

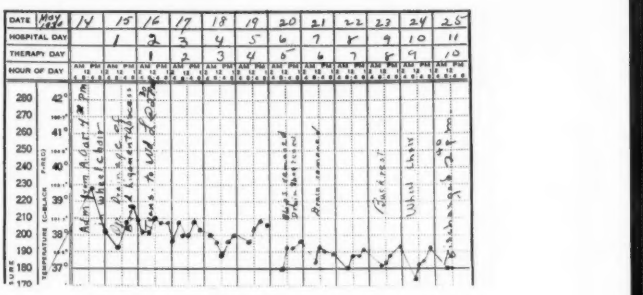

Fig. 5. Temperature chart showing rapid defervescence following extraperitoneal drainage of a parametric mass.

CASE 10. G. M., aged 25 years, was admitted to the hospital May 14, 1930, and was discharged May 25, 1930. The patient was a young white woman 25 years of age, I-para; three miscarriages. She complained of severe pain in the right lower quadrant of 10 days' duration. Patient had been approximately 6 weeks pregnant and had had an induced abortion. For 10 days she had had chills and a sanguineopurulent discharge. Temperature was 39.4 degrees C. on admission. Hæmoglobin was 85 per cent; white blood cells 24,000. Pelvic examination revealed a marital outlet, the cervix normal in consistency, the uterus slightly enlarged, pushed forward to the left by a large mass continuous with the uterus and, curved around in horseshoe fashion in the lateral pelvic wall apparently outside the peritoneum. An inguinal incision was made and the external oblique aponeurosis was opened, a finger pushed under the conjoined tendon medial to the femoral vein. A large stony hard mass was encountered and about 3 drams of serum escaped. The mass was explored with the point of a Kelly clamp for a short distance. No pus was encountered. Two cigarette drains were placed in the sinus tract and the incision sutured about them. The following day the pain was relieved. She had an uncomplicated gradual defervescence and was discharged on the tenth day, in good condition with the wound almost healed. The pelvic mass had become very much lessened in size, was much softer, and there was no tenderness on the right side. We felt that her convalescence had been much shortened by the incision and drainage (Fig. 5).

SUMMARY

The clinical course of patients operated upon for parametric exudates, even during the period of firm infiltration, has led us to believe that the extraperitoneal placing of drains away from exudates in this region shortens the convalescence and definitely lessens the morbidity when compared with patients treated expectantly by position, rest, heat, only. These patients are infinitely more comfortable after incision and the placement of a drain down to the base of the broad ligament even though only a small amount of fluid or pus is evacuated at the time of incision. The defervescence following incision, as may be seen from several typical temperature charts (Figs. 2, 3, 4, and 5), occurs by a gradual decline through the course of a number of days or occurs abruptly, sometimes several days after incision. The immediate effect of the drainage may be a transient exacerbation of the febrile reaction of the patient as is frequently true following any operative procedure in a region of inflammation. This series of cases has been followed since operation and the postoperative condition of all is satisfactory.

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ANEURISM OF THE PULMONARY ARTERY

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WHILE true aneurisms of the pulmonary artery are rare as compared with those of the aorta, they do occur with sufficient frequency to be considered in the differential diagnosis of tumors of the mediastinum. The subject of pulmonary aneurism receives scant attention in the literature and is not discussed by the majority of textbooks. Aschoff and Kaufmann merely mention its rarity. Hirschfelder very briefly reviews Henschen's article. Henschen, in 1906, thoroughly searched the literature and compiled 46 cases of aneurism involving some portion of the pulmonary trunk or its two main branches. He discussed these cases from various viewpoints and attempted to explain their etiology. In 1909 Posselt discussed Henschen's work and added 9 new cases. The aneurisms of the smaller pulmonary branches associated with tuberculous cavitation of the lung and the mycotic or infectious embolic aneurisms described by Eppinger, are not uncommon. These, however, are not considered to be true pulmonary aneurisms.

It is our purpose in this paper to report an unusual case of pulmonary aneurism and to collect the cases reported since the work of Posselt in 1909. This case was observed during a period of 3 years, was studied with the X-ray and the electrocardiograph, and its surgical removal was attempted, the attempt ending in the death of the patient.

B. U., a white female student 19 years of age, was admitted to the Bell Memorial Hospital May 14, 1926, with the complaint of hoarseness, partial aphonia, and dyspnœa. From the patient's mother it was learned that at the age of 3 days the patient was short of breath and at times was "blue." During early childhood she was able to run and play as other children but when 7 years old she began to be dyspnœic on exertion. At the ages of 11 and 17 she had influenza following which her dyspnœa became more severe, forcing her to leave school. At the same time increasing hoarseness developed. For the past 3 years she has expectorated, at intervals, small amounts of rusty colored sputum and at one time a small quantity of red blood. For the past 2 years she has complained of indefinite dull pain in the substernal region. Her activities have gradually decreased so that at the time of her admission to the hospital she was able to do only the lightest tasks about her home.

There was no history of rheumatic fever, tonsillitis, chorea, scarlet fever, or venereal disease.

Physical examination showed a well developed girl of 19, breathing with some difficulty at the rate of 24 a minute. Her face and neck were flushed and her lips were purplish-red. The veins of her neck were distended and pulsating. The pupils were dilated, equal, and reacted to light and accommodation. The conjunctiva and retinal vessels were congested. The ears, nose, and throat were negative. The thyroid was not palpable. The chest was well formed but there was a distinct bulging of the manubrial area, greatest on the right side at the level of the third rib. Pressure over this elevated area elicited slight dull pain. Tactile and vocal fremitus were normal. The breath sounds over the entire chest were harsh. D'Espines sign was positive. The relative cardiac dullness measures 4 centimeters to the right and 12 centimeters to the left. The first pulmonic sound was thudding and the second greatly accentuated. After exercise there was a pre-systolic thrill and rumble at the apex. The radial pulses were small, equal, regular, and varied from 78 to 100 per minute. There was a diastolic murmur at the apex and along the left sternal border. The blood pressure in each brachial artery was the same, 110 millimeters mercury systolic and 80 diastolic. The abdomen was normal in contour; the liver palpable and slightly tender. There was no œdema of the extremities. The finger nails were cyanotic and there was slight clubbing of the finger tips. The deep reflexes were slightly exaggerated. Laryngoscopic examination showed an abductor and adductor paralysis of the left vocal cord.

X-ray examination (Fig. 1A) showed a 30 per cent enlargement of the left heart shadow, including the aorta. In addition there was a rounded mass lying in the region of the aortic arch on the left side and another triangular area of similar density projecting outward from the right hilus shadow. (Fluoroscopic examination showed no pulsation of these tumor masses.)

Examination of the urine showed nothing abnormal. Red blood cell count was 4,300,000; hæmoglobin (by Sahli) was 90 per cent and the white count numbered 10,600, with a normal differential count.

The Wassermann reaction was negative.

The clinical diagnosis made was mitral stenosis, mediastinal tumor and paralysis of the left recurrent laryngeal nerve. Along with symptomatic treatment the patient was given deep X-ray therapy to the mediastinal masses.

An electrocardiographic tracing (Fig. 2) showed an increase in the magnitude and a definite right sided cardiac hypertrophy. Four weeks following the X-ray treatments another plate (Fig. 1A) showed no change in the size of the tumor masses, but they had a more definite outline and their shadow was denser.

Two months later the patient was again admitted and showed no essential change in the physical signs. An X-ray of the chest showed little change (Fig. 1B). Patient was given another course of X-ray therapy and dismissed.

On November 10, 1926, the patient was again admitted complaining of increasing hoarseness, dyspnœa and some palpitation and cough. The physical findings were unchanged. The X-ray examination showed a slight increase in the size and considerable increase in the density of the tumor masses (Fig. 1C).

Twenty-seven months later (part of which time she had spent in a high altitude with considerable symptomatic relief) the patient was again admitted and showed a definite increase in hoarseness, slightly more dyspnœa, and an increase in the cyanosis. At this time her fingers and part of her hands were bluish and the finger tips definitely clubbed. The bulging of the manubrial area was increased, and the patient complained of a more distressing dull aching in the chest beneath this area. She had had two attacks of hæmoptysis each lasting about an hour but with little loss of blood. There had been a constant, irritating cough with

only a little rust colored sputum. The X-ray examination at this time showed the tumor masses to be slightly increased in size and density (Fig. 1D). The red blood count was 6,000,000 and the hæmoglobin 120 per cent.

It was believed that the mediastinal masses were some kind of benign tumor, possibly dermoid cysts, and following the patient's repeated request an attempt at their removal was made. A posterior incision was made along the seventh rib to the midaxillary line and a portion of the seventh rib was removed. An extrapleural dissection was done and a firm tumor mass easily exposed. The capsule of the tumor was incised and an attempt made to enucleate its content which appeared to consist of grayish-brown, cellular material. After a small amount of this material had been removed there was a sudden and fatal gush of blood.

The autopsy, performed within an hour after death, was limited to the removal of the heart through the surgical incision. The heart, with proximal portion of the aorta and pulmonary artery, weighed 623 grams and showed a definite right sided hypertrophy (Fig. 3). It measured 11 centimeters from base to apex, 11 centimeters across the base and 7 centimeters anteroposteriorly. The pericardium was smooth and glistening. The myocardium of the right ventricle measured 20 to 35 millimeters in thickness while that of the left ventricle 10 to 15 millimeters. The muscle was firm in consistency, dark reddish-brown in color, and showed a little yellowish mottling in the papillary muscles. The circumferences of the valve rings were as follows: tricuspid 9.5 centimeters, mitral 4.5 centimeters, pulmonary 8 centimeters, and aortic 4 centimeters. The foramen ovale was wide open, measured 22 millimeters in diameter almost forming a cor triloculare. The aorta measures 1.6 centimeters in diameter and had thin, soft pliable walls similar to that of a child of 10 years. The pulmonary trunk and the two main branches up to the point where they enter the lung tissue were greatly dilated, and were completely filled with laminated grayish-brown thrombotic material which showed some organization of the layers next to the arterial wall. The trunk measured 4.3 centimeters in diameter. The left branch appeared as a rough spheroidal mass and measured 7 centimeters in diameter. The right branch was roughly cylindrical and measured 4 centimeters in diameter. The smaller branches were not dilated and arose abruptly from the distended portion and measured 3 to 6 millimeters in diameter. They were flattened out over the thrombosed aneurysmal mass. The large veins from the neck and upper mediastinum were also flattened over the mass as they approached the heart. The ductus Botalli appeared as a slender fibrous cord and its lumen was entirely occluded. The smaller branches of the pulmonary artery showed numerous yellowish-white, elevated, diffuse thickenings of the intima.

Histological section of the heart muscle showed fragmentation, segmentation, some granular degeneration and slight lymphocytic and plasma cell infiltration with a patchy increase in stroma. Section of the aorta showed a thickened intima which was indefinitely outlined from the media. There was slight calcification in the intima. In the media there was some wrinkling and slight perivascular infiltration of plasma cells and lymphocytes. Attached to the intima of the pulmonary artery there was a dense mass of hyalinized material showing numerous young fibroblasts and other evidence of the partial organization of the thrombosed aneurysm. The wall of the pulmonary artery was markedly thickened, mostly in the media and adventitia. In the media and adventitia there was considerable wrinkling and distortion of the elastic fibers. Section stained with Verhoeff's elastic tissue stain showed the scarcity and in places the absence of these fibers with their replacement by hyalinized cicatricial fibrous tissue. About the vasa vasorum of the adventitia and media there was considerable perivascular lymphocytic and plasma cell infiltration with swelling of the endothelial cells (Fig. 4). The orderly parallel arrangement of the elastic fibers was broken up and distorted by the round cell infiltration producing a wrinkled, scarred, inflammatory appearance suggesting a syphilitic arteritis. Section of the small pulmonary arteries showed in the adventitia and media a typical perivascular lymphocytic and plasma cell infiltration with swollen endothelial cells, distortion of the adjacent elastic fibers and secondary atheromatous changes in the media and intima (Fig. 5). The atheromatous areas contain material readily stained with Scharlach R. Levaditi preparations were negative for spirochætæ pallidæ.

In the light of the autopsy findings the clinical symptoms can be readily explained. The association between the dyspnœa and cyanosis of infancy and childhood with the widely patent foramen ovale is obvious. The vocal cord paralysis was undoubtedly due to the pressure of the thrombosed aneurism upon the left recurrent laryngeal nerve as it passes under the arch of the aorta. Pressure from the slowly growing aneurism partly collapsed the superior vena cava producing congestion and cyanosis of the hands, face, and neck. The almost complete thrombosis of the pulmonary trunk and branches increased the pressure and accounts for the marked right sided cardiac hypertrophy and the greatly accentuated second pulmonic sound. The non-pulsating bulging of the manubrial area was a direct result of the gradual increase in size of the aneurism and its thrombosis.

The clinical diagnosis of pulmonary aneurism is very difficult there being only one case reported in which an antemortem diagnosis proved by autopsy has been made. Henschen believes that the diagnosis of pulmonary aneurism can be made when the following signs are simultaneously present:

1. Prominence of the second and third left costal cartilage with well defined dullness and X-ray shadow in this area.
2. Intense cyanosis, other signs of congestion, hæmoptysis and substernal pain.
3. Pulsation and well defined thrill and murmur in the second left interspace.
4. Loud superficial rasping systolic murmur.
5. Right sided cardiac hypertrophy.
6. Absence of dilatation or hypertrophy of the left heart (i.e., apex dullness within the midclavicular line).
7. Absence of usual signs of aortic aneurism (viz., dullness to right, difference in pulse, recurrent laryngeal paralysis).

In our case the first, second, and fifth signs were present. The third sign was entirely absent

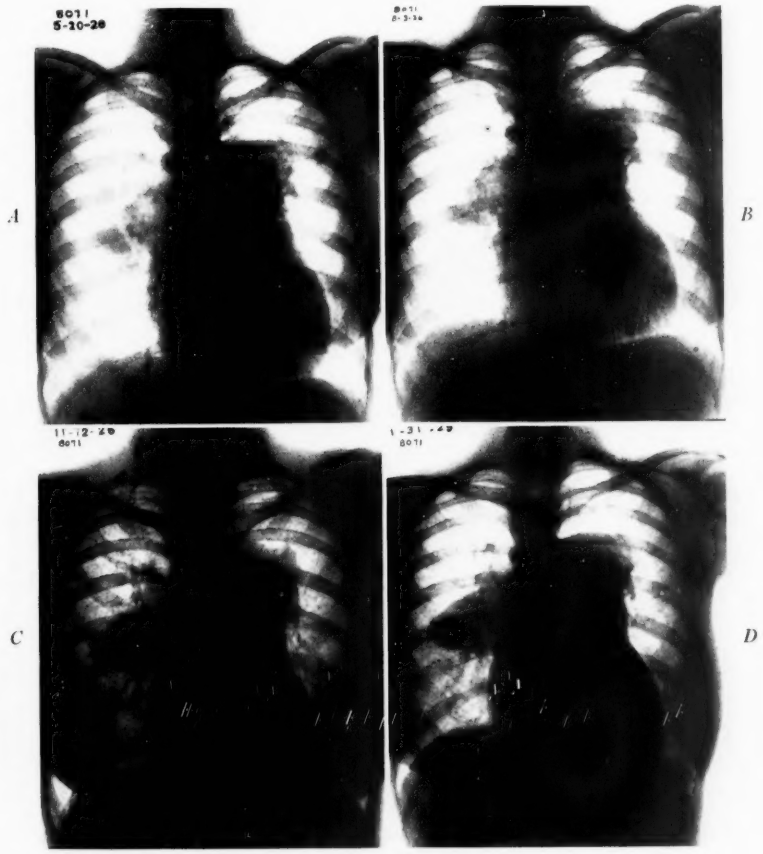

Fig. 1. *A*, Roentgenogram of heart showing cardiac hypertrophy with indefinitely outlined masses in right and left mediastinum. *B-C-D*, Roentgenograms taken at different intervals showing gradual increase in density of the masses due apparently to increasing amounts of thrombotic material in the aneurismal sac.

due to the almost complete thrombosis of the entire trunk and bronchus. The fourth sign was altered, the murmur being presystolic and rumbling in character, accompanied by a thrill and possibly due to the very widely patent foramen ovale. The sixth sign was indefinite because although the left heart actually was not hypertrophied the X-ray shadow and the findings by percussion strongly suggested a definite left sided hypertrophy. The seventh sign was of minor importance for the patient had a number of the important findings of aortic aneurism, such as substernal pain and oppression, dyspnœa, cough (though not "brassy" in character), palpitation, hoarseness and a visible tumor.

Fourteen cases verified by postmortem examination have been collected from the literature since Posselt published 9 additional ones in 1909. They are briefly abstracted as follows:

Case 1. Reported by Reiche. Male, aged 17 years, had actinomycosis of the chest and mediastinum with draining sinuses, with continuous, loud, diastolic-systolic murmur at the base. Autopsy showed saccular aneurism the size of a cherry seed located on the posterior surface of the artery near its bifurcation.

Case 2. Reported by Barth. Male, aged 57 years. Six years before had a "stroke." Autopsy showed pulmonary aneurism, right sided cardiac hypertrophy. Wall of aneurism and pulmonary artery showed histological picture similar to a syphilitic aortitis.

Case 3. Reported by A. Ploeger. Woman, aged 52 years, had had cardiac pain for 22 years associated with

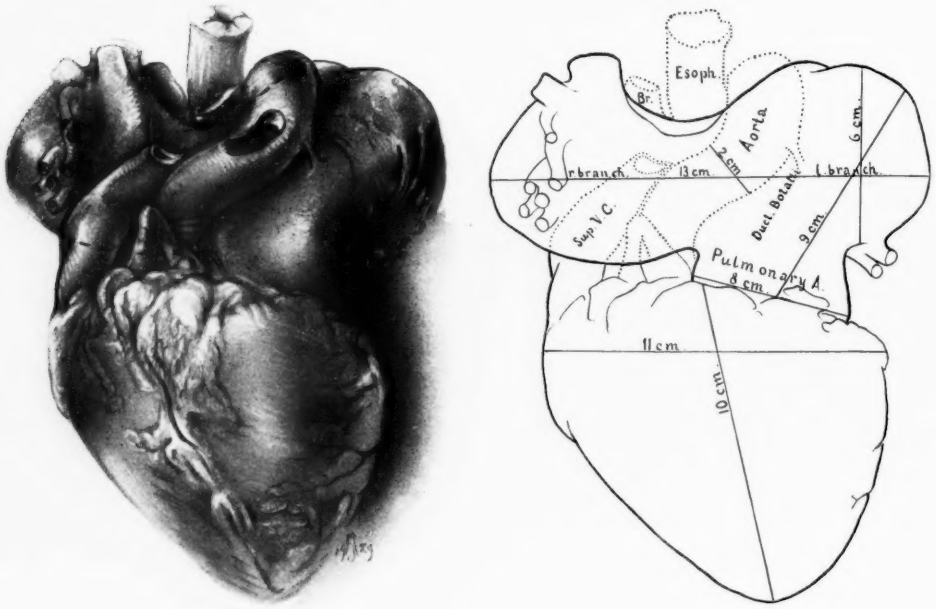

Fig. 2. Drawing of heart and aneurism of the pulmonary artery showing its relations and size (reduced ½).

cyanosis and dyspnœa. Loud systolic murmur was present over mitral area. Pulse irregular, hyaline casts in urine, fingers clubbed, X-ray film showed dilated shadow in pulmonic area. Varicose veins and œdema were noted in both lower extremities with an old hyperplastic periosteitis near the malleolus. Autopsy revealed extensive sclerosis of the pulmonary artery and enlarged heart, especially in the right, atherosclerosis of aorta, chronic ulcerative tuberculosis of upper left lobe, gall stones, dermoid cyst of right ovary, old cystic hæmorrhage of the brain and a large saccular aneurism of the pulmonary artery partly occluded by a thrombus. The wall showed a typical perivascular inflammatory reaction characteristic of lues. No such reaction was seen in the aorta. Author considered aneurism to be luetic in origin.

Case 4. Reported by Letulle and M. Jacquelin. Male, aged 58 years, entered hospital 30 hours before death. He had had dyspnœa, cardiac arrhythmia, cyanosis, and general œdema. The heart was large and dilated. No history of lues was given, but history of rheumatism. The cyanosis was out of proportion to the condition of the heart and lung. He died suddenly. Autopsy revealed a fusiform aneurism of the right pulmonary artery with its lumen largely occluded by a laminated clot. The ductus Botalli was closed and the right ventricle was hypertrophied and dilated. The wall of the arteries and of aneurism showed a perivascular reaction suggesting a luetic reaction.

Case 5. Reported by Marble and White. Male, aged 25 years, lieutenant, had a gunshot wound of the right chest. Abnormal dullness to percussion was noted on right side. Loud systolic-diastolic murmur present at apex. X-ray examination showed dense spherical shadow at the base of the right lung. Numerous pulmonary hæmorrhages preceded death 5 months after wound. Autopsy showed aneurism of the right pulmonary branch, the size of an orange, located 4 centimeters distal to the bifurcation of the trunk. A large valve-like opening connected with a bronchus.

Case 6. Reported by Foster. Male, aged 23 years, had precordial pain, cough, dyspnœa, and dysphagia, with cyanosis. Definite visible and palpable pulsation were noted over the upper sternum. Paralysis of one vocal cord present. Fluoroscope showed pulsating tumor in upper mediastinum. Wassermann was strongly positive. Patient had pneumonia. Autopsy showed aneurism of the pulmonary artery.

Case 7. Reported by Blechman and Paulin. Infant had a funnel shaped aneurismal dilatation of the pulmonary trunk, the larger part being at the ostium. There was a congenital interventricular opening. Ulcerative pneumococcic endocarditis.

Case 8. Reported by Sutherland. Female, aged 4 years had progressive cardiac failure with œdema of lungs, dyspnœa, and cyanosis. Autopsy showed aneurismal dilatation of the pulmonary trunk and left branch beginning ¼ inch from the pulmonary ostium and extending to the lung. The aneurism measured 3.8 centimeters in diameter and throughout its entire length was occluded by a firm thrombotic mass. The ductus arteriosus was a thin fibrous cord.

There were other congenital anomalies. There was a supernumerary toe, the fourth and fifth digits were fused and the fifth finger had a double nail.

CASE 9. Reported by Arrillaga. Male, aged 40 years, gave a history of hæmoptysis, cyanosis, dyspnœa, and neck vessels unusually congested. X-ray examination showed a dilatation of pulmonary artery. Pulmonic second sound was accentuated. Wassermann was strongly positive. Autopsy revealed sclerosis of the pulmonary artery with aneurismal dilatation of the trunk.

CASE 10. Reported by Arrillaga. Male, 38 years, with history of weakness, œdema and cyanosis, had the right ventricle enlarged. Rales were heard over both bases, systolic murmur at the apex. Wassermann was negative. Autopsy showed an aneurism of the pulmonary artery with rupture into the pericardial cavity. Atheromatous placques were abundant in the wall of the aneurism.

CASE 11. Reported by Arrillaga. Patient gave a history of dyspnœa, œdema, and cyanosis, especially of head and neck. X-ray examination showed a dilated right heart and dilatation of the pulmonary artery. Second pulmonic sounds were accentuated. The autopsy showed arteriosclerosis of the pulmonary artery with a saccular aneurism of left branch of pulmonary artery. Macroscopic appearance suggested lues. Treponema was demonstrated in the lungs and in the walls of the pulmonary artery.

CASE 12. Reported by Moench. Female, aged 29 years, housewife, had dyspnœa and vertigo. Death occurred suddenly. She had always been well and had worked hard. There was an aneurismal dilatation of the pulmonary trunk measuring 7.6 centimeters in diameter with linear rupture on the anterior surface and the pericardial sac was distended with fresh blood. The ductus Botalli was patent, easily admitting the index finger. The mitral valve was thickened and the aorta showed a few atheromatous placques.

CASE 13. Reported by Poinso. Female, aged 35 years, had precordial pain, dyspnœa, and cyanosis. The Wassermann was 2 plus. Autopsy showed cylindrical dilatation of the trunk with thrombosis and partial canalization. Microscopic examination showed arteritis with miliary gummata about the vasa vasorum, and fragmentation of many of the elastic fibers.

CASE 14. Reported by Warthin. Male, aged 37 years, had chancre 28 years ago, frequent pulmonary hæmorrhages, hoarseness, cough. The point of maximum cardiac impulse was outside the nipple line, diastolic murmur was in third intercostal space transmitted upward. Wassermann 4 plus. X-ray diagnosis was neoplasm. Autopsy revealed the aortic arch dilated and showed luetic aortitis. An aneurism of branch of pulmonary artery, size of guinea hen's egg, was filled with laminated blood clot, the wall showing the gross appearance of syphilitic arteritis; hepatitis with multiple gummata.

The etiology of pulmonary aneurism is not definitely established and it is probable that no one factor will explain them all. Henschen believes that syphilis is the most frequent and important agent and cites 12 cases in which syphilitic lesions were found (macroscopically). Because but few of his cases were accompanied by histological pictures, the true incidence of syphilis may have been considerably higher. Posselt says that, while it is true syphilis is an important factor in producing pulmonary aneurism, it must be remembered that atheromatous changes also cause the condition and thinks this process is probably the basic and essential rôle. He considers that atheromatous changes begin in the smaller pul-

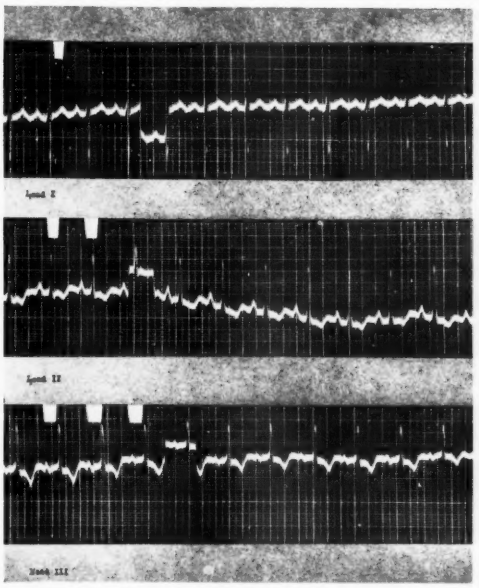

Fig. 3. Electrocardiogram showing right sided preponderance and increased magnitude of deflection.

monary branches as well as in the trunk and the consequent reduction in the lumina of the pulmonary tree increased the blood pressure which causes a dilatation in the already diseased vessel wall. Peck has shown that syphilis of the pulmonary vessels is a rare finding, only 29 undoubted cases in the international literature and only 3 cases of syphilitic pulmonary aneurism which macroscopically and microscopically gave pictures comparable to aortic syphilis. Warthin has reported a case of pulmonary aneurism and has demonstrated the spirochæta pallida in the wall of the aneurism near the adventitia. Poinso's case showed miliary gummata.

Sex has apparently little etiological significance, only a few more cases being found in the female than in the male.

About 40 per cent of the cases occur under 30 years of age. This is in distinct contrast with aortic aneurisms in which only 18 per cent occur under 30 years (Hirshfelder).

Congenital malformations of the heart unquestionably play a part in the etiology of pulmonary aneurisms. The most frequently occurring type of malformation is the patent ductus Botalli—8 of Henschen's cases and one of Posselt's cases showing this. Moench reported a case in which the ductus Botalli would easily admit one's index

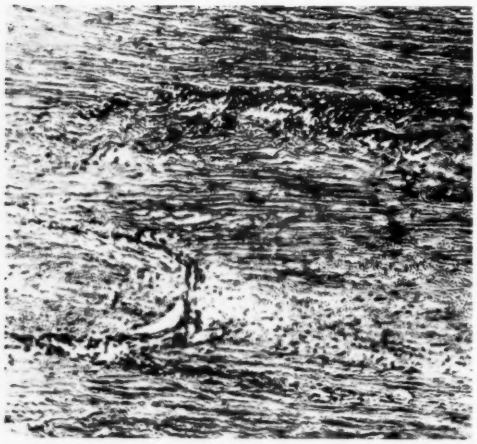

Fig. 4. Section of wall of pulmonary artery showing perivascular inflammatory reaction and scarring in the media (× 100) similar to characteristic lesions in luetic mesaortitis.

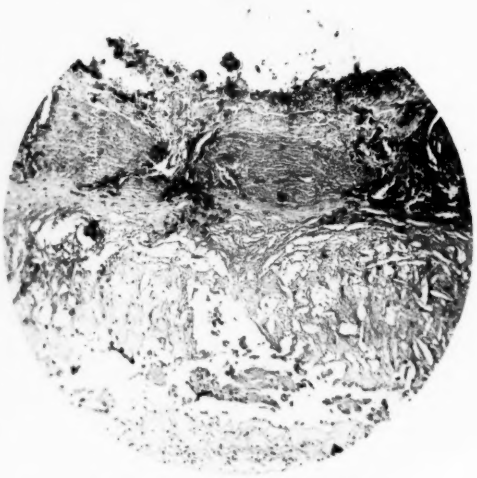

Fig. 5. Section through branches of pulmonary artery showing typical perivascular inflammatory reaction with atheromatous change (× 85).

finger, and he thinks congenital cardiopathy is probably the essential factor in the etiology. However, many patent ducti Botalli unassociated with pulmonary aneurism and vice versa are seen. The association of pulmonary aneurism with aortic stenosis, pulmonary stenosis, patent foramen ovale, aplasia of aorta or pulmonary trunk, is also frequently noted among the reported cases. Blechman and Paulin's case had a patent interventricular septum. The frequency of the association of malformations of the heart with pulmonary aneurisms may have its explanation in the fact that in such congenital hearts greater strain is thrown upon the pulmonary aorta than the systemic aorta, and if there is an underlying arteritis (usually luetic) the wall would be weakened and a gradual dilatation ensue.

Endocarditis and pericarditis are probably unrelated, or secondary rather than causal.

Trauma has been an etiological factor in two cases, Konjetzny and Marble and White.

In our case there was no history or stigmata of syphilis, the Wassermann reaction was negative, and we were not able to demonstrate the spirochæta pallida with Levaditi preparation. The histological picture, however, of the pulmonary trunk wall, the wall of the aneurism and of the smaller pulmonary branches was exactly comparable to that so frequently seen in syphilitic arteritis and the aorta. Lymphocytic and plasma cell perivascular infiltration with endothelial reaction, fragmentation, distortion and cicatrization of the elastic fibers along with the secondary atheromatous change leads us to think of this process as probably syphilitic in character. This patient's clinical course and mistake in diagnosis illustrates the importance of considering pulmonary aneurism in the differentiation of obscure mediastinal masses.

SUMMARY

This is a detailed report of a typical aneurism of the pulmonary artery in a young woman. It was opened by mistake, having been considered a solid mediastinal mass, and resulted in fatal hæmorrhage. There is also a brief summary of 14 new cases confirmed by autopsy to be added to those described by Henschen in 1905 and Posselt in 1911, making a total of 70 cases in the literature.

These aneurisms are usually associated with some congenital anomaly of the heart and often have a syphilitic base. They have been reported most frequently in relatively early adult life. Their occurrence is sufficiently frequent to emphasize their consideration in the diagnosis of mediastinal masses.

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POLYPS OF THE LARGE INTESTINE[1]

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IN the attack on carcinoma the conviction is deepening that little is to be gained from the further study of the histological picture of full grown carcinoma, and that there is more promise in the field of possible precancerous formations. Carcinoma appears practically eight times as often in the sigmoid and rectum as it does elsewhere in the colon, and polyps of the large intestine maintain in their growth approximately this same ratio of distribution. The sigmoid and rectum are thus the commonest sites for both forms of new-growth, a fact that at once points to a suspicious relationship between them.

In the aggressive surgery of the day, removal of a malignant growth in the sigmoid or rectum ordinarily is accomplished by resection with it of long reaches of the lower part of the colon. It is this practice that brings to the pathologist not only matured carcinomata but also areas of the sigmoidal and rectal mucosa exceeded only by the skin and its appendages in extent of available sites for the study of precancerous changes. Accordingly, it is to these resected specimens of the polyp-bearing mucosa of the colon that this work is addressed. We propose in this study: (1) to review the histopathology of polyps; (2) to show that they are not all of a piece and that under the name are included definitely precancerous formations; and (3) to trace from such formations the growth of numerous outright and deep-seated carcinomata of the large intestine.

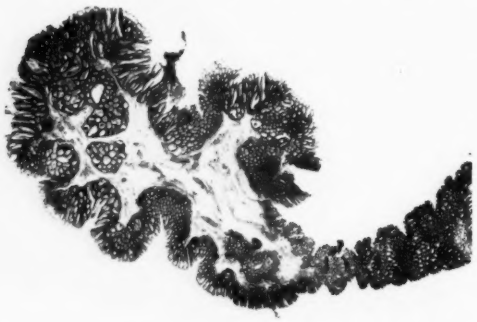

Fig. 1. Polyp of group 1. Nodular, pedunculated tumor. The epithelium of its surface and crypts remains entirely normal. Nuclear activity in the loose areolar stroma is at a minimum.

In the reports of cases, only autonomous new-growths, true blastomata of the intestinal mucous membrane not yet clear cut carcinoma, are considered under the term polyp. This restricted use of the word calls for arbitrary exclusion of the polypoid formations seen in hyperplastic tuberculosis, and so often at the edges of ulcers in ulcerative colitis and in the regenerated mucosa of colons constricted by the latter disease. These inflammatory epithelial proliferations have come to be widely enough recognized as the possible precursors of cancerous change to entitle them to separate consideration and direct attack.

In the literature that has grown up around the study of polyps of the large intestine, various classifications of the growths have been proposed, some based on supposed etiological factors, others on the clinical manifestations of the tumors, and still others on their internal histological structure. Nearly 40 years ago, Hauser, excluding all formations having a possible inflammatory background, argued that polyps could be grouped according to the amount of degenerated epithelium within them. Wechselmann, in 1909, devised a three-phase classification but, like Hauser, limited his critical analyses to the epithelial elements of the tumors. Schmieden and Westhaus, in 1927, by introducing consideration of selected attributes of the connective tissue framework, pedicle formations, and macroscopic appearance, rendered the Wechselmann criteria much more useful. These latter authors stressed in particular precancerous changes in polyps.

THE PATHOLOGICAL ANATOMY OF POLYPS

We shall attempt here to continue the work of establishing for polyps a histological classification. On examining the tumors it can be seen that they fall readily into three major histological divisions as follows:

Polyps of group 1. In this group are included only those growths in which the epithelium retains its normal characteristics. The tumors are usually roughly nodular, although in some of the speci-

[1]Abridgment of thesis submitted by Dr. FitzGibbon to the faculty of the Graduate School of the University of Minnesota in partial fulfillment for the degree of Master of Science in Surgery, 1930.

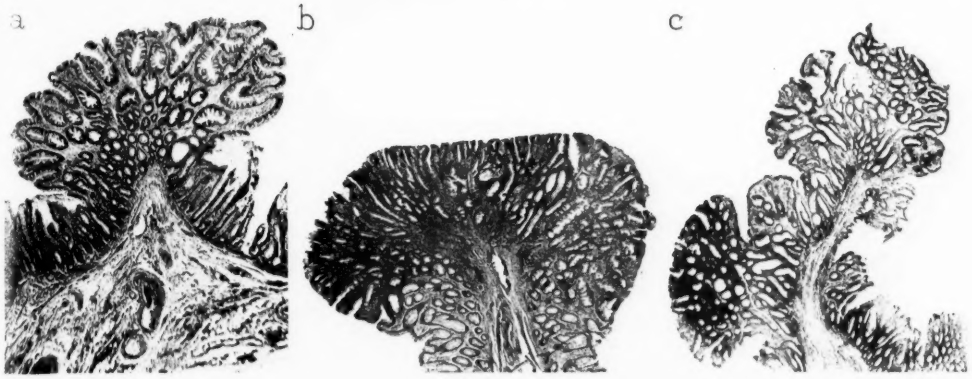

Fig. 2.

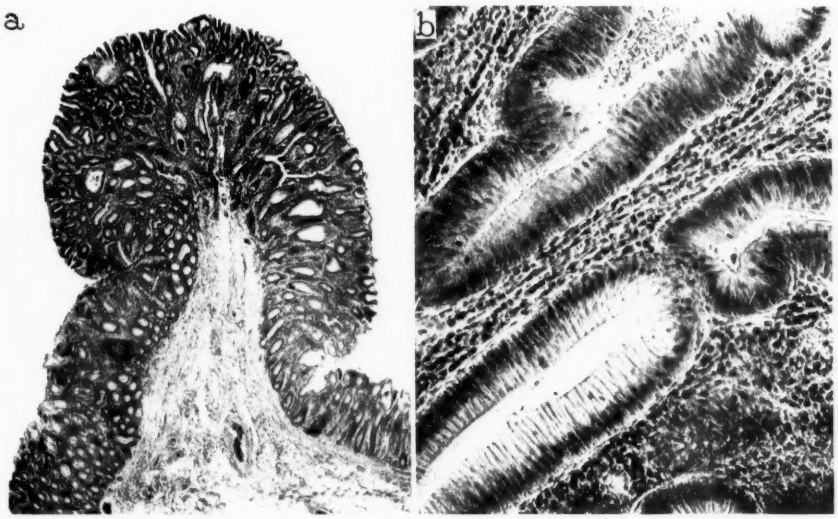

Fig. 3.

Fig. 2. Early growth of polyps of group 2. a, Tiny bud of enlarged and deformed glandular tubules. The tug of the proliferation on the submucosa is already apparent. b, Drift of connective tissue is to left side of the tumor where darker, more active proliferation is in progress. c, Maturing polyp (6 millimeter). There are two dark areas of active proliferation still within it.

Fig. 3. Early polyp of group 2. a, Extremely active polyp, 3 millimeters in diameter, at an early stage of development. The proliferative, dark-staining polyp epithelium contrasts sharply with the normal mucosa from which it springs. b, Characteristic polyp epithelium. The sector of the tubule at the bottom of the picture contains normal goblet cells. In the center is seen an intermediate stage in the development of the true polyp epithelium appearing in the upper tubule, a tubule formed by elongated, compressed, multilayered cells with dark-staining, rod-shaped nuclei.

mens the surface is smooth and regular. Although the epithelium covering the growth and lining its crypts is unchanged from the standard regarded as normal, nevertheless there may be in scattered areas some evidence of slight hyperplasia. Such areas are the sites of more or less active inflammation secondary to the constant trauma to which the tumors in their exposed positions are constantly subjected. Polyps of this group vary in size from tiny clubs about 3 millimeters in diameter to masses 1 or 2 centimeters in cross section (Fig. 1). Loose connective tissue derived from the

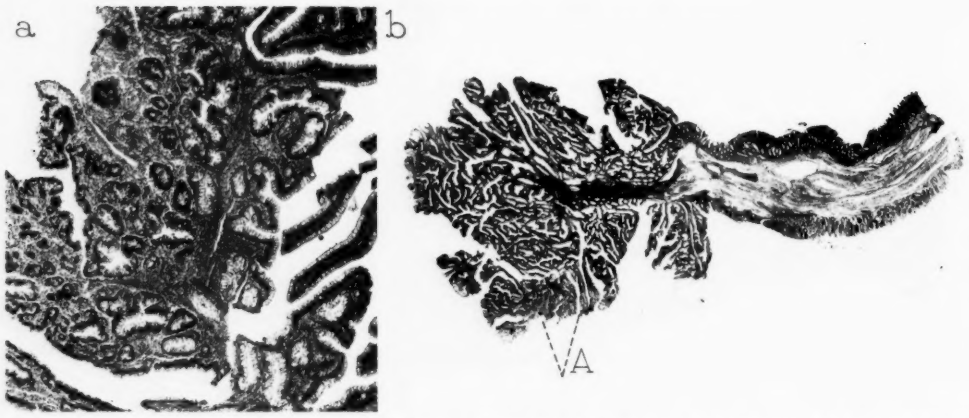

Fig. 4. a, Enlargement of area marked *A* in Figure 4 b, the site of a microscopic (2 millimeters) adenocarcinoma, graded 2. b, Long stemmed, aged polyp of group 2 from splenic flexure of colon resected for generalized polyposis. Case 1.

submucosa forms the matrix of the stalk and expands to sustain the nodular polyp. There is no tendency in growths of group 1 to branching or papillary forms.

Polyps of group 1 are invariably pedunculated. Even in the smallest tumors of this group encountered in our specimens there is evidence of formation of a stalk. The pedicles are usually cylindrical structures of variable lengths up to 6 centimeters or more, composed of connective tissue derived from the submucosa and covered with normal appearing mucous membrane. Sometimes, in the heavier tumors, the pedicle becomes flattened into a ribbon-like strip. In polyps of this group, it is thought that the formation of the pedicle is due purely to mechanical factors arising outside of the tumor itself. As the little knob proceeds into the lumen of the intestine, it is played on by the forces of peristaltic action and the current of the intestinal content, and so pulled out that a stalk more or less attenuated is produced.

It must be recognized that peristalsis, evoked in the intestinal musculature by the irritation of what is virtually a foreign body, can attain in this region great force. Instances are recorded in which polyps of this type have been amputated from the tips of their pedicles not by ulceration but by outright avulsion by peristaltic action. Then, too, numerous cases of intussusception have resulted from the peristaltic pull on the tumors. The patient from whom was taken the polyp shown in Figure 1, had to submit three times to operative intervention for the relief of acute intestinal obstruction. Each time, intussusception of some degree was found, and each time a polyp of this type was at the bottom of the trouble.

It is conceivable that whatever initiates carcinomatous change in polyps could likewise find its expression in the epithelium of this group. There is, however, nothing about the tumors of group 1 to indicate that they are any more liable to malignant development than is normal intestinal mucous membrane. It can, therefore, be said that the polyps of group 1 are destined to a long and benign course. No such pronouncement can be made, however, for the polyps of group 2.

Polyps of group 2. The polyps of this group are easily distinguished from those of group 1 by the abrupt and striking structural changes in both the epithelium and in the connective tissue elements. The epithelium is characterized by widespread failure of the proliferating cells to differentiate completely into the units of normal intestinal mucosa. In the polyp epithelium the cells are hypertrophied, elongated, and by their increased bulk compressed from side to side. They may stay arranged in single rows, but in numerous places the press of overgrowth piles them into multilayered buds that project usually into the lumens of tubules and frequently into the connective tissue matrix as well. The nuclei, like the cells, are elongated. They are stained more deeply by all the routinely used dyes and thus give to the proliferation a darker and easily recognized color. In the cellular protoplasm, the production of mucus is sharply diminished.

These epithelial changes do not appear equally advanced over the whole of the group. Usually there is a peripheral dark zone of greater cellular

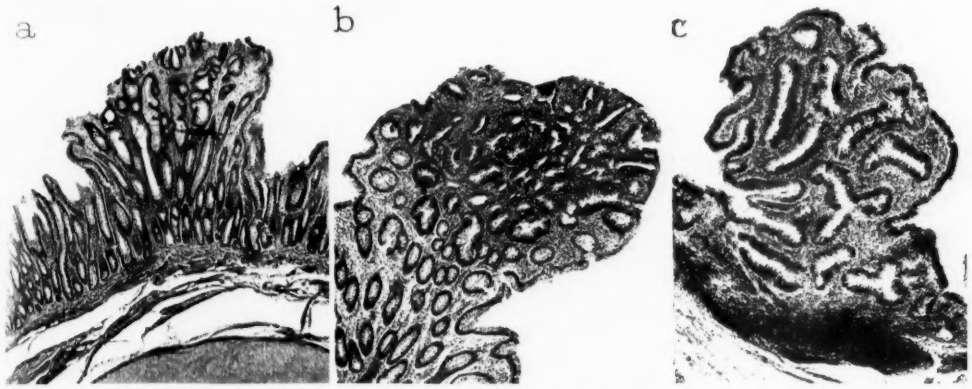

Fig. 5. The growth of polyps of group 3. a, Sprout of enlarged tubules lined by typical polyp epithelium initiating the growth. b, Continued proliferation of polyp epithelium. No evidence of stalk formation, such as occurs in group 2 can be seen. c, The polyp epithelium has completely suppressed the growth of normal tubules and has already reached the muscularis mucosæ.

activity where this changed epithelium will first be found, particularly in the early forms of this group. As the polyp ages, the changed epithelium will have displaced entirely the more differentiated structure which it has infiltrated, overgrown, and choked.

The peripheral dark zone so characteristic of growing polyps is composed almost entirely of complexes of glandular tubules. These tubules, increased both in diameter and length by the hypertrophy of the component cells, crowd and press one another into a tangled mass. One frequently finds cellular activity at its height at those points where the epithelium of the tubule debouches onto the surface of the tumor and spreads out over it to form its investing membrane. In places one can see the tubules of the polyps projecting down between the more normal glands at the base of the tumor. Nearly every polyp of this type reveals cystic enclosures which have been formed by the accumulation of secretion in the deformed and obstructed glands.

As this process of epithelial proliferation goes on there is a complementary response in the connective tissues of the submucosa. The tug of the tumor soon pulls the muscularis mucosæ and some fibrils of the underlying looser areolar tissue upward to form a tiny stalk. If the tempo of growth is not too brisk, the connective tissue elements are drawn out into ever-branching divisions which form a tree-like supporting scaffolding for the epithelial complexes. At irregular places, however, in polyps of this group, the epithelium may grow out in long, tender tendrils that give to these areas a shaggy, papillary structure. It is these tendrils

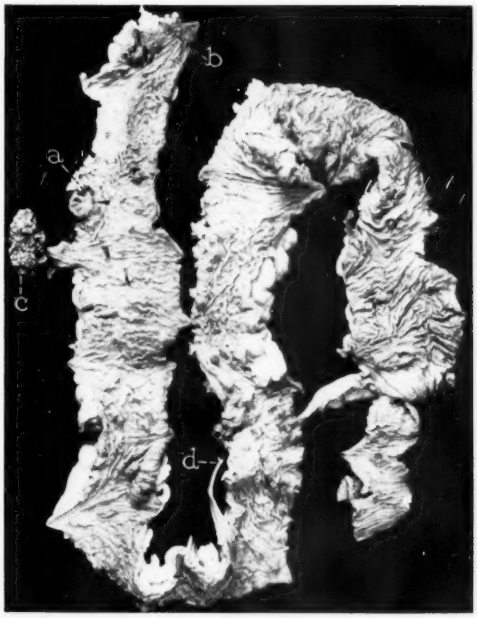

Fig. 6. An entire colon removed *en masse* for generalized polyposis. a, Deeply penetrating adenocarcinoma, graded 2. b, Site of microscopic adenocarcinoma, graded 2, in a polyp of group 3. c, Massive polyp of group 2 in which are regions of adenocarcinoma, graded 1. d, Pedicle of a polyp of group 2 which became detached in handling but which is exactly similar to the one at c. See also Figures 7 and 8. Case 1.

Fig. 7. Cross section of deeply penetrating adenocarcinoma graded 2 shown in Figure 6a. Compare the low-power enlargement (Fig. 7b) of this carcinoma with one found arising in a nearby polyp of group 3 (Fig. 8a). Case 1.

that are readily injured by intestinal action and are thus the sources of the hæmorrhages that so mark the course of these tumors.

The polyps of group 2 are also invariably pedunculated. Two massive, egg-sized tumors (6 by 4 centimeters) of this group in our specimens swung from pedicles fully 6 centimeters in length, a pattern which other and smaller polyps followed in their own ways. It is true that one frequently sees flattened, hemispherical excrescences set apparently in or on the intestinal mucosa like a plush or velvet-covered button in overstuffed upholstery. These tumors are called sessile tumors. The overhanging edges of the growth have concealed the stalk. A cross section through the tumor will reveal the short, stubby pedicle and the true cauliflower structure of the polyp. Many of these sessile growths are, in fact, congeries of innumerable smaller growths, each organized in this cauliflower-like fashion.

Polyps of group 2 usually show somewhere within them evidences of inflammatory processes; at least, areas are to be found actively infiltrated with round cells. These inflammatory reactions which appear in the tumor are ordinarily completely absent in the adjacent normal mucosa and can, therefore, be regarded as results of the inescapable trauma to which such growths exposed to the intestinal current must submit.

In the accompanying illustrations, the development of the polyps of group 2 can be traced from the earliest buds to matured proliferation. Figure 2a depicts a tiny bud of mucosal glands in which the tubules are already enlarged and deformed and in which the darkened polyp type of epithelium makes its appearance. Even at this stage the tug of the proliferation is felt by the muscularis mucosæ and the areolar tissues of the submucosa and a rudimentary stalk is being formed. In Figure 2b is shown evidence of the unequal proliferation in a growth slightly more advanced. It will be noted that the darker and more active area of the tumor lies to the left, and toward it there is an early drift of connective tissue branching. In Figure 2c in a pea-sized (6 millimeter) polyp of this group, there are two areas of dark colored cellular activity on the periphery of the growing tumor.

The sharp contrast between true polyp epithelium, as described in the foregoing paragraphs, and the normal type of intestinal mucosa from which it springs is well shown in Figures 3a and 3b. This tumor does not cap a mucosal fold, as do so many of the proliferations. The growth was found on the broad side of a sigmoidal fold. The cellular activity in the tubules and the multilayered buds projecting into the lumen of the gland are plainly shown.

The polyps of group 2, with their connective tissue foundations laid out to follow a well considered plan of tree-like formation, attain to the largest size in these tumors. All the large tumors of our specimens, and all the larger tumors of which there is adequate pathological description in the literature, fall at once into this group. This group then will embrace most of the polyp formations developing in the large intestine. That the growths are not, however, consistently benign, is well known. Figure reveals the fate that so often overtakes these

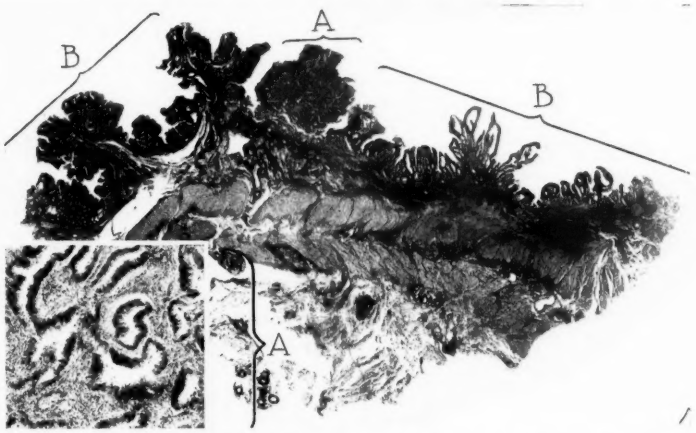

Fig. 8. Tiny, microscopic areas of adenocarcinoma, graded 2, arising in congeries of polyps of group 3. *A*, Adenocarcinoma, graded 2. *B*, Polyps of group 3. Compare low power enlargement of this carcinoma (inset) with similar enlargement made of tissue of nearby deep-seated adenocarcinoma, graded 2, shown in Figure 7b. Case 1.

tumors. The area of outright carcinoma (adenocarcinoma, graded 2), is microscopic in dimensions. Had not the section luckily gone through this tiny carcinoma, the character of the growth surely would have been misjudged. In fact, this particular polyp, like many others in the series, was sectioned as a routine and pronounced benign. How many of these tumors are mislabeled, no one can know. Certainly, it is out of the question, in every day laboratory practice, to submit all of them to serial sectioning.

It would seem that the development of carcinoma in polyps depends on the rate at which the tumor is driven to grow. In the slow paced formations of group 1 there is little, if any, likelihood of cancerous change. In the relatively more rapid growth of the polyps of group 2 it is a question only of time until carcinoma appears. Apparently, intestinal epithelium cannot proliferate indefinitely, even at a moderate rate, without ultimately losing its bearings. This matter of rate of development is strikingly illustrated in the polyps of group 3.

Polyps of group 3. In the polyps of this group, as in those of group 2, there has been failure of epithelium to differentiate. But in this group are only those tumors in the epithelium of which the processes of differentiation have been arrested at so early a stage that the cells have attained only the most rudimentary characteristics of the normal units of intestinal mucosa. There is thus no sharp line of separation between polyps of groups 2 and 3, as there is between polyps of groups 1 and 2. Polyps of group 3 are but accentuated forms of the growths of group 2, in which cellular activity reaches its height for such tumors. And thus, too, there is formed a twilight zone into which may fall tumors bearing the characteristics of both groups. Although in this border zone there are not always clear-cut distinctions between polyps of the two groups, yet it is useful to maintain this three-phase classification. In the older polyps of group 3, the cellular changes are advanced and unmistakable; in the younger polyps, other and secondary features of the tumors help to identify them for grouping.

Polyps of group 3, like those of the other groups, must start in an overgrowth of glandular tubules in the mucosa. At first there is prolongation and enlargement of the tubules. These regions of incipient proliferation are so small that they will escape observation unless they are sought for with a sufficiently powerful lens. Certain authors, endeavoring to show that polyps are the result of primary injury inflicted on the intestinal mucosa at points of increased friction, and on the flexures and the mucosal folds, maintain that these early proliferations are situated on the tops of the folds, where secondary traumatic inflammatory reaction would most commonly occur. We found the sites of these tiny growths to be not so much on the tops of the folds as scattered haphazard over the mucous membrane. The little growth shown in Figure 5a was taken from the trough, and not the

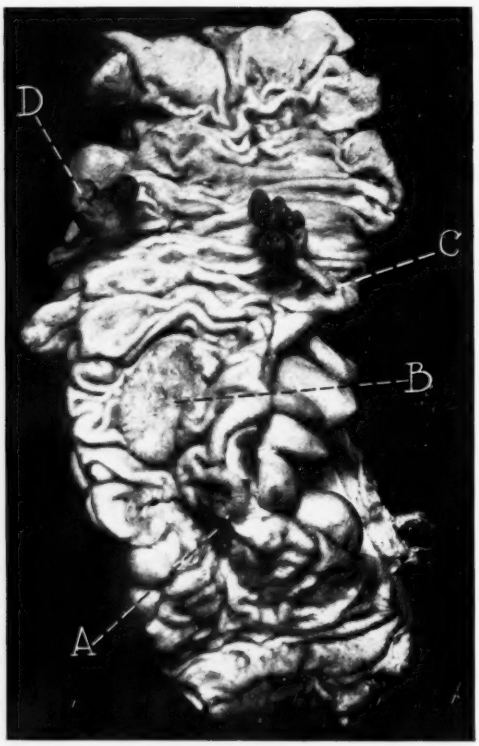

Fig. 9. Specimen from rectosigmoid. *A*, Adenocarcinoma, graded 2. *B*, Adenocarcinoma, graded 2. *C* and *D*, Polyps of group 2 extensively involved in adenocarcinoma, graded 2. See also Figures 10 and 11. Case 2.

crest, of one of these folds. The slightly more advanced growth in Figure 5b occurred on the stalk of a polyp of group 2. In Figure 5c, however, is a proliferation of group 3, taken from the height of a fold.

Polyps of this group attain ordinarily only the size of a split pea (6 to 8 millimeters). This uniformly restricted size of growth can be interpreted in but one way. The elementary epithelium proliferates so rapidly that the nodule approaches cancerous change before the tumor has become large enough to be played on by the forces of peristaltic action or before the more temperate connective tissues have a chance to respond to such demands for growth. Figure 5c shows this changed epithelium already in actual contact with the submucosa.

It is this lag in the connective tissue stroma that gives to polyps of group 3 their characteristic appearance of rank confusion in the epithelial overgrowths. Cellular activity at the points where the tubules open on the surface must result in a disorganized nodule if there is no connective tissue to support an orderly papillary projection. And a similar course must be followed in the buds in the tubules themselves. Here the enlarging tubules must grow downward, as there is no structure to sustain an upward proliferation; and, in fact, tubules are to be seen proceeding into the normal mucosa from which they have developed and which they will ultimately infiltrate, compress and destroy. As in group 2, the irregular tubules become so convoluted that they are frequently obstructed, and numerous cysts are formed behind them. All in all, in the polyps of this

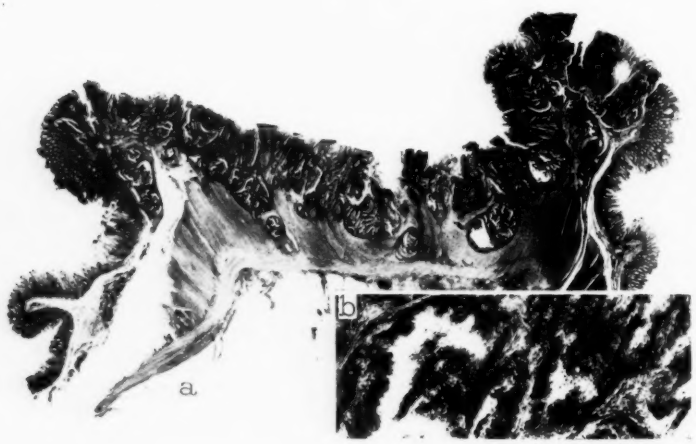

Fig. 10. a, Section of adenocarcinoma, graded 2, marked B in Figure 9. The carcinoma has advanced to the serosa and there remain in it only scattered traces of a former polyp epithelium, but confirmatory evidence that this carcinoma had its origin in polyp is contained in the neighboring growths, one of which is pictured in Figure 11. b, Enlargement of this carcinoma. This may be compared with one of polyp in Figure 11a. Case 2.

Figure 11. a, Microscopic appearance and b, cross section through a polyp of borderline group 2-3, 1.5 centimeters in diameter, suspended on a pedicle 3 centimeters long (Fig. 9C). The polyp is practically destroyed by the advancing adenocarcinoma, graded 2. Had not the growth of this carcinoma been cut short by the extirpation, the picture shown in Figure 10 inevitably would have been produced. Case 2.

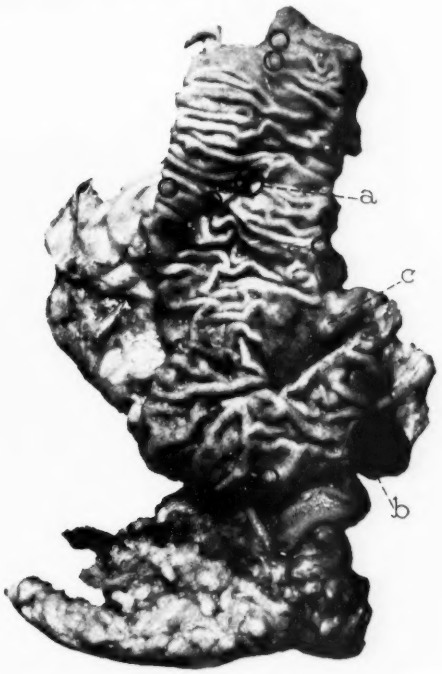

Fig. 12. Resected segment of the rectum and rectosigmoid showing: a, Site of polyp of group 2, 1 centimeter in diameter. Sites of other and smaller polyps of group 2 are circled. b, Polyp of group 2, bearing an area of papillary carcinoma, graded 1. c, Deep seated, destructive adenocarcinoma, graded 1. Case 3.

group no recognizable attempt is made at organoid formations. In addition, cells of these epithelial complexes can no longer be distinguished morphologically from those seen in outright carcinoma. It apparently is but a matter of relatively short time until polyp proliferations of this type burst the barriers of the muscularis mucosæ and become actually deeply infiltrating, that is, carcinomatous.

In considering the sites of the proliferations of group 3, it was mentioned that they have been found scattered throughout the intestinal mucous membrane. Similar areas of this same type of proliferation are to be seen also on the surface of some polyps of group 2. In these buds of solid cords of epithelium, the cells, no longer moored to the glandular structure of the tubule, have thrown off their columnar cell characteristics and have become one-eyed vesicles, the form for the repeatedly described and so called carcinoma cell.

We are prepared to prove that the site of origin of deep seated destructive carcinomata of the colon is in these proliferations of the mucous membranes of group 3. The finding of such an order of proliferation in polyps of group 2, polyps which in themselves in time become carcinomatous, points directly to the conclusion that carcinoma of the colon is mediated through proliferations of group 3 wherever their situation.

It may be well to repeat here that the nodular polyps of group 1 pursue ordinarily a benign career, that the orderly but more rapidly growing polyps of group 2 tend in time to malignant changes, and that formations of the order of group 3 are outrightly precancerous. The data on which these ideas are based will be found in the forthcoming presentation and analysis of the cases of polyposis in this series. The first 3 of the 13 cases are reported with considerable fullness, the remainder in less detail, and all are summarized in the table.

Fig. 13. Congeries of polyps of group 3 in which are areas of adenocarcinoma, graded 2. This is the second of three separate carcinomas in this specimen. There is striking resemblance of this picture to one shown in Figure 8. The Schultze picture is present. Case 5.

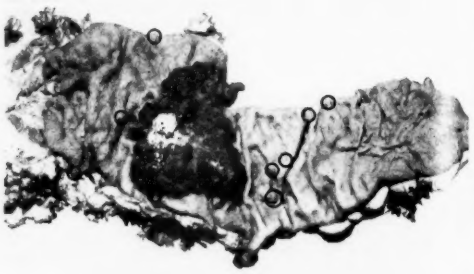

Fig. 14. Resected portion of rectum and rectosigmoid. A cross section of this massive polyp of group 2 is shown in Figure 15b. The sites of numerous smaller polyps of group 2 and group 3 are circled. Case 9.

REPORTS OF CASES

CASE 1. The patient is a woman aged 25 years. The mother who is living is said to have carcinoma. All her life the patient has had diarrhœa; she did not remember that she ever passed formed stools. On the day of her first examination at the clinic 100 cubic centimeters of blood was lost in rectal bleeding. Over a period of many years she had not observed any change in her general condition and had not lost weight. The concentration of hæmoglobin was 16 grams in each 100 cubic centimeters of blood. On proctoscopic examination multiple polyposis was discovered, beginning just above the anus and involving the bowel as far as it could be seen. There was a scarred area 2 centimeters in diameter, about 3 centimeters above the anus. Above this and to the right was another similar area that appeared malignant. A specimen was removed and was diagnosed as adenocarcinoma, graded 1, in an adenoma.

Abdominal exploration was made and ileostomy was established. Three months later, the entire colon was removed *en masse* with 14 centimeters of ileum and the upper portion of the rectum. Shortly afterward, at posterior resection, the rectal stump was recovered.

Pathological changes. The two gross specimens, the one consisting of 14 centimeters of the terminal part of the ileum, 70 centimeters of the colon down to and including the upper portion of the rectum, and the other of the rectal stump, were both involved in a generalized process of polyposis. In the upper rectal segment was a hard, ulcerated and deeply excavated, button-like, oval area 3.5 centimeters long by 2.5 centimeters wide, obviously carcinoma. Of the innumerable polyps, two were of notable size (Fig. 6). One of these polyps was a giant, raspberry-like growth, 6 centimeters long, 4 centimeters wide, and 2 centimeters thick from a sturdy pedicle arising in the mucosa near the ulcerated carcinoma just described. The other similar but slightly smaller one hung into the lumen at the splenic flexure. Scattered over the colon were hundreds of other pedunculated polyps varying in size from those whose tiny stalks were hardly visible to others of dimensions of 2 by 2 centimeters. Studding the mucosa between these pedunculated growths, and more closely in the rectum, were still other uncounted hundreds of minute, warty excrescences 1 to 5 millimeters in diameter, so called sessile polyps. The mucosa, except at the site of the carcinoma and at the bases of the polyps, was normal in appearance and texture. The folds that ordinarily mark the mucous membrane of the colon were still maintained.

Microscopically all of the little sessile growths encountered in this specimen were typical polyps of group 3, conforming to the descriptions and illustrations given for this type of tumor (Figs. 5, a, b, c). The large ulcerated area was an adenocarcinoma, graded 2. No trace of a former polypoid stage of development could be seen within the growth (Fig. 7). But remarkably enough in a conglomerate mass of little polyps of group 3 surmounting a rectal fold was discovered a tiny adenocarcinoma, graded 2, 2 millimeters in diameter (Fig. 8), which had destroyed all evidence of mucosa at this point and had already advanced deep into the submucosa. In the massive pedunculated polyp suspended in this same neighborhood were discovered, likewise, areas of adenocarcinoma, graded 1. And in the big, pedunculated polyp, described as arising near the splenic flexure, were similarly discovered areas of adenocarcinoma, graded 1. Both of these polyps were otherwise typical and unsuspected tumors of group 2. Numerous other polyps of this same order, group 2, were scattered about. Polyps of group 1 were not found in the specimen.

This specimen offers for analysis a remarkable array of polyps in all phases of development, and more uncommonly, four separate centers of carcinomatous change, each presenting its own picture in the progressive growth of deep lying and destructive carcinomata of the colon.

In Figure 8, the minute and microscopic adenocarcinoma, graded 2, derived from progressive changes in polyps of group 3 already had penetrated deep into the submucosa, destroying it as it destroyed the mucosal elements above it. Obviously it would have been only a brief time until this advancing growth would have attained the size of the larger carcinoma near it. The

Fig. 15. a, Carcinoma growing in the remnants of tubules of a polyp of group 2. Numerous islands of polyp epithelium have so far escaped destruction in this growth. b, Cross section of massive sigmoidal tumor pictured in Figure 14. Case 9.

histological pictures of these two growths in two different periods of development were so nearly identical that they could be used practically interchangeably (Figs. 7b and 8A). The larger of the two carcinomata is thus to be regarded as the older brother of the smaller one. But we have actually seen the tiny cancerous offshoot, microscopic in dimensions, arising in polypoid progenitors of group 3. It follows, then, that the histogenesis of the two growths was the same, and hence they are forms of the same type of growth and differ only in point of age, although in the larger tumor all evidence of a former polypoid structure had been destroyed.

In the initial areas of carcinomatous change in the peripheral parts of the two massive polyps of group 2 were proof, also, that even stable old growths of this type tend ultimately to malignancy. It would seem that polyps of group 1 and group 2 are the products of a proliferative disease of the intestinal mucosa when the rate of development of that disease was slow and its import benign. Polyps of group 3, on the other hand, are its products when the disease is progressing at an accelerated pace.

Case 2. In the family of a woman, aged 38 years, there was no history of carcinoma. Only 5 weeks before the patient came to the clinic she was first made aware of change in bowel habits by the onset of diarrhœa. This diarrhœa, together with abdominal distention and cramps, persisted until operation.

Proctoscopic examination revealed an annular carcinoma involving the lower end of the sigmoid. Motion was limited on the left posteriorly and the bowel was partially obstructed. Two polyps appeared below and at the sides of the growth. An obstructive type of resection was done. Subsequently the opening made at colostomy was closed.

Pathological changes. The specimen consisted of 20 centimeters of sigmoid (Fig. 9). In the upper third of this segment of the bowel were two lesions, each 3 centimeters in diameter. Both portions were deeply ulcerated; the ulceration in the higher of the two extended through all the coats of the bowel and into a mass of indurated tissue which penetrated 3 centimeters or more into the mesenteric attachments. At a level of about 5 centimeters below these destructive growths were two racemose polyps, each 1.5 centimeters in the greatest diameter and each suspended from opposite sides of the sigmoidal walls by stems 3 centimeters long. In the mucosa, below the growths and extending to the lower limits of the specimen, were twelve or more tiny, warty excrescences ranging from 1 to 5 millimeters.

Microscopically the deeper penetrating growth which involved the mesenteric nodes by direct extension was adenocarcinoma graded 2, and the nearby, but slightly smaller, lesion was likewise adenocarcinoma, graded 2. Furthermore, in the heart of each of the two polyps cut on their long stems was adenocarcinoma, graded 2, of the precise histological picture as presented by that in the penetrating carcinomata. Microscopic enlargements of all four of these separate carcinomata were indistinguishable one from the other (Figs. 10a, b and 11a, b).

The two large polyps, except for their regions of malignant change, were of the order of group 2 or 3. The general structure of the polyps was that of common types of group 2, but the epithelium of the tubules not involved in the cancerous process was extremely dark, exceedingly active, and in occasional areas only was there any evidence of production of mucus (Fig. 11). The smaller, scattered polyps were all typical growths of group 3, tiny tufts of mucosa capped by unsupported congeries of polyp tubules in the process of active proliferation.

In this case, as in the preceding one, there appeared four distinct centers of advanced carcinoma. The only interpretation that logically can be offered for this situation is that four of the numerous proliferations of group 3 noted in the foregoing analysis have progressed to outright carcinomatous forms. It might be con-

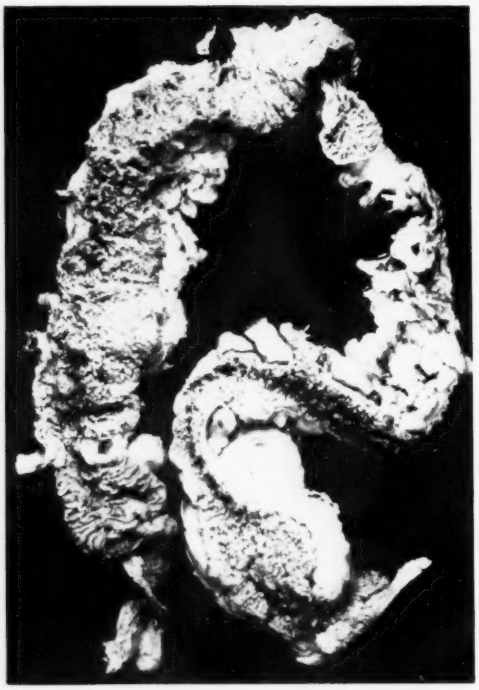

Fig. 16. Colon resected for generalized polyposis. The dense growth of innumerable polyps of borderline group 2-3 is strikingly shown. Case 13.

tended justly that the two major, deeply penetrating growths are of the same origin. Without serial sections of the disputed portion, this objection could not be silenced. However, the point could be granted without reducing the force of our interpretation of the march of events in this instance. There would still remain three regions of equally destructive carcinomatous formations appearing in three separate structures, two of them in removed and disconnected polyps of group 3.

CASE 3. One uncle of a man aged 56 years died of carcinoma of the stomach, and another uncle of carcinoma of the bowel. Only 3 months before coming to the clinic the patient's life-long bowel habits were interrupted by the onset of much rectal tenesmus which could be relieved by the passage of varying amounts of stool, mixed with blood and mucus. Proctoscopic examination disclosed, high in the posterior rectal wall, an easily movable cauliflower mass.

Biopsy revealed the growth to be an adenocarcinoma graded 1. Combined abdominoperineal resection of the rectum and rectosigmoid was accomplished, with simultaneous colostomy by inguinal stab wound.

Pathological changes. The gross specimen was 25 centimeters of rectum and rectosigmoid. About 10 centimeters

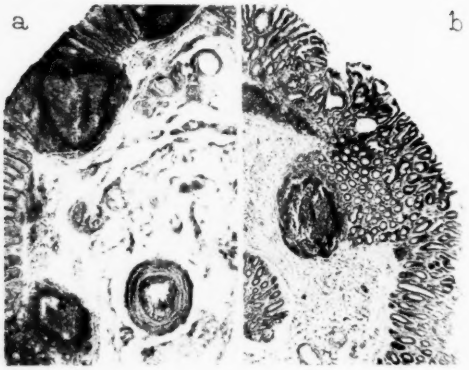

Fig. 17. a and b Progressive steps in the repair of injury to mucosa and submucosa caused by rupture of inflamed lymph follicles by means of downgrowth of normal epithelial elements. It may be noted that the normal and not the overlying polyp epithelium participates in the ingrowth. In Figure 13 is an example of this process being carried on at large scale.

above the anal margin was a flat, warty excrescence, centimeters long and 3 centimeters wide, which projected above the surface of the bowel 0.5 to 1 centimeter. In the center of this mass was a small region of ulceration with loss of substance. Within 4 centimeters of this growth and at its approximate level was a large, pedunculated, mulberry-like polyp, 2.5 centimeters in diameter. This tumor was much darker than the flatter one, and in the gross was an excellent example of what passes routinely in laboratory practice for a pedunculated adenoma. About 6 centimeters above these two major growths was another nodule 1 centimeter in diameter. It was situated on the crest of a fold of mucous membrane and in its color and texture it was not changed from the normal appearing mucosa from which it arose. On closer inspection there were to be seen throughout the mucous membrane, on the ridges of the folds and in their depths, numerous tiny warts, some so small that they would have escaped recognition except for the use of the hand lens, and others ranging up to 2 millimeters in diameter. These little warts in color and texture were also like normal mucous membrane (Fig. 12).

Microscopically the large pedunculated tumor was a typical polyp of group 2 but in many places over its surface were numerous finger-like proliferations, papillary carcinoma, graded 1. Acini and crypts in this growth could easily be located which would be lined in part by epithelium of group 2 and in part by outright cancerous growths. In the cross section of the large tumor was a deep seated, destructive growth, adenocarcinoma, graded 1. In this carcinoma, which had destroyed in its area most of the muscular ture of the outer intestinal walls, pictures were to be seen that could as well have been taken from the pedunculated polyp. Here the carcinoma was developing on remnants of polyps of group 2. Here also the carcinomatous and polyp cells lined the same acinus or met on the surface to form the investment of the tumor.

A sessile growth that was 1 centimeter in diameter was a typical polyp of group 2. Evidence of carcinomatous change could not be found in it at this time. The other and smaller polyps were all incipient growths of group 2, the tiny stalks sustaining early polyp formations.

In this specimen were presented clear cut pictures of the progress of events from proliferations of group 2 to deep seated carcinoma. In Figure 12, a, is shown a so called benign polyp, in Figure 12, b, there appears outright carcinoma in an exactly similar polyp; and the carcinoma appearing in the unmistakable remnants of group 2 polyp (Fig. 12, c), has proceeded to the destruction of all but the outer coats of the intestinal wall. In the face of these pictures, no other interpretation of the processes of growth of this destructive carcinoma could reasonably be offered.

CASE 4. In this case masses of carcinoma appeared in bulky polyps of group 2. No one would dispute the origin of such formations. If the patient had not reached operation, and the ulcerating growths were thus allowed to enlarge, it is obvious that it would be but a short time until all evidence of this preliminary polypoid state would be destroyed.

There was also an active polyp of group 2 or 3 between two large carcinomata, obviously, too, carrying within itself the developmental patterns of the two older growths. Had this polyp been situated in the proximal loop and gone undetected, in all probability the patient would soon be facing a recurrence.

CASE 5. In this case also (Fig. 13), as in the preceding case (Case 4), multiple centers of carcinoma of undoubted polypoid origin were present. The sites of the carcinomatous changes were at once apparent. The solitary polyp of group 2 in this case was obviously older than the similar one in the specimen of Case 4 and was itself already involved in actual carcinomatous proliferation.

CASE 6. There are two bulky carcinomata in this case as there were in the two preceding cases (Cases 4 and 5). They call for no detailed tracing of their development. The origin of tumors of this type in polyps is self-evident and everywhere admitted.

CASE 7. In the specimen which represented this case were two advanced adenocarcinomata, graded 2. The cross sections made of both carcinomata failed to show any evidences of a former polypoid phase in the growths. However, there were likewise present in the specimen numerous exceedingly active polyps of group 3. It would be difficult to assign any other origin to these carcinomata than the overgrowth of two or more of these rapidly proliferating polyps.

CASE 8. Unless the regions of the carcinoma in this case, which had not yet come to ulceration, were examined microscopically the growth would be said to be an adenocarcinoma, graded 3, without evidence of a former intermediate polypoid stage of development. The close identity of structures in the upper and intact portion of the major growth with those seen in the adjacent polyp makes it difficult to deny that the major penetrating growth had its origin in polypoid proliferations.

CASE 9. A massive carcinomatous growth (Figs. 14 and 15), like the two major growths in Cases 4, 5, and 6, appeared in this specimen. Attention need not be given here to tracing the details of its development. Cross section of this carcinoma is self-revealing. The case is inserted simply to record another instance of outright, deep seated, destructive carcinoma arising in polypoid soil.

CASE 10. The specimen which represents this case presented another example of malignant outgrowth of extensive polypoid proliferations. It may well be that not all the centers of carcinoma in this broad expanse of polyp formation were primary growths. Many of them were certainly branching projections of a central nidus. But it is sufficient for our thesis to show that there was one such nidus in the tumor. There was no evidence of carcinoma other than in this polyp. Therefore the carcinomatous change must unquestionably have started in the polyp.

There was a sessile polyp of group 3, near the upper border of the carcinoma. This polyp which was about to be included by the malignant advance, pictures the fate that must often overtake these numerous tumors at those times when a high grade carcinoma has taken possession of the field.

CASE 11. Figure 5, a, b, c, illustrating standards of classification for our grouping, was taken from the specimen which exemplifies this case. With plain evidence of restless activity in the cells of the numerous polyps it would be difficult to regard them as guiltless in the formation of the large and destructive carcinoma which appears in the specimen. It must be remembered, too, that it is not uncommon for polypoid growths to be suppressed to actual regression once a fullgrown carcinoma dominates the proliferative activities of a field.

CASE 12. This is a case of widespread but slowly progressing proliferative disease of the gastro-intestinal mucous membranes. Except for the symptoms arising in the duodenal ulcer, the patient's difficulties through 13 years were due to purely mechanical derangements secondary to these slowly growing but large tumors.

CASE 13. In the remarkable specimen which represents this case (Fig. 16) polyp epithelium of group 3 reached its maximum for all these cases both for intensity and extent of its activities. The disease was called polyposis. It could have been called as well adenocarcinoma, graded 1, but tradition and the textbooks oppose such a diagnosis. Perhaps the presence in the specimen of the innumerable, long stemmed polyps gave to the diagnosis its dubious benign cast. Long pedicles, it seems, have high standing, at least clinically, in the criteria of innocence in new-growths. And perhaps, too, a pathologist could not be expected to term these tumors carcinoma, when they are in such great numbers, even though they are all but characteristic of carcinoma. One has only to consult the literature or to refer to Case 1 of this series to be reminded that these tumors would have become carcinomata had not their life been cut short by extirpation. But we will have to content ourselves with calling this precancerous polyposis.

RECAPITULATION

The data gathered for the reports of cases are hardly suitable for statistical presentation. All but 3 of the 13 cases so reported came to operation because of carcinomata known to be present in the several rectal and sigmoidal colons. Only two of the specimens were extirpated primarily for polyposis. Thus an analysis of these specimens, the polyps of which were secondary considerations in the operative indications, will not reflect the incidence of such tumors in any representative number of colons. But this study, directed as it is into a review of the histopathological characteristics of polyps and into the histogenesis of carcinoma of the colon, does reveal some arresting relationships between the two forms of new-growths for this particular

POLYPS OF THE COLON AND CARCINOMATA DERIVED FROM THEM

Case	Polyps		Carcinomata		
	Number and distribution	Group	Site	Grade	Polyp, group from which derived
1	Generalized polyposis	2 and 3	Rectum Rectal ampulla Sigmoid Splenic flexure	2 2 1 2	3 3 2 2
2	2 large and 4 scattered	2 and 3	Sigmoid Sigmoid Sigmoid Sigmoid	2 2 2 2	2 2 2–3 2
3	6 scattered	2	Rectosigmoid Rectosigmoid	1 1	2 2
4	Solitary large and 11 small	2 and 3	Rectum Sigmoid	2 2	2 2
5	Solitary and congeries	2 and 3	Sigmoid Rectum Sigmoid	1 2 3	2 2 2–3
6	Remnants only in the carcinoma	2	Rectum Sigmoid	2 2	2–3 2–3
7	8 exceedingly active	3	Rectum Sigmoid	2 2	3 3
8	Solitary and remnant in carcinoma	2	Rectum Rectum	3 1	2–3 3
9	10	3	Rectum	2	2
10	2 large and 5 small	2 and 3	Rectosigmoid	2	2–3
11	12	3	Rectum	1	3
12	1 cæcal and 3 in descending colon	2 and 1	None		
13	Generalized polyposis	2 and 3	None		

series. The arrangement in the tabulation of the pathological changes found in our cases presents a summary of these relationships.

In the 13 cases of polyposis of the colon, in either the generalized or localized form, there appeared 24 carcinomata. These 24 carcinomata were distributed through 11 of the cases (85 per cent) and thus only 2 cases were free from malignant change. In 8 of the 11 cases, 21 of the 24 growths developed and the ratio of incidence of multiple to single malignant growths in this polypoid soil was 8:3.

For 19 of the 24 carcinomata (79 per cent) there was, in the several specimens themselves, indisputable histological proof that the sites of origin of the malignant growths were in polyps. For 3 of the remaining carcinomata there was the most persuasive and convincing proof for the same site of origin. For only 2 of the 24 carcinomata does one have to go outside of the specimen itself for plausible evidence of such an origin. And, accordingly, however scrupulous one may be in the matter, 22 of the 24 carcinomata (92 per cent) can be shown to be derived from polyps. If microscopic slides picturing the carcinomatous change in the polyp are not demanded as proof of such change, and if evidence of analogous and demonstrable developments in similar cases is acceptable as proof, then all of these carcinomata can be shown to have this origin in polyps.

There thus remains only the malignant growth in Case 2 and the one in Case 11, for the histogenesis of which one has to look outside the specimen itself. Although these two carcinomata destroyed by overgrowth and ulceration their own evidence of an earlier stage as a polyp, such evidence legitimately can be supplied to them from any of the other numerous cases in which the derivation of the carcinomata can be traced back, in unbroken lines, to polyps. In the study of the histogenesis of these 24 carcinomata is the inescapable conclusion that carcinoma of the colon develops from an earlier stage as a polyp or through an intermediate stage as a polyp and not otherwise. Certainly, in the light of this evidence, the burden of proof is on anyone who might wish to show that carcinoma of the colon develops in any manner other than through formation of polyps.

An analysis across these data in the opposite direction to determine how many polyps actually became cancerous would be an impossible task. In the cases of generalized polyposis there were literally many thousands of these tumors. Such numbers alone made impractical any plan for sectioning them all. And further, in the bulky polypoid carcinomata arising in congeries of polyps of group 3, one could never tell how many of the tumors were involved primarily in the change or how many were affected by secondary invasion of the malignant growth once it came to dominate the field. It is thus more important to observe that in every case but one in which there were polyps of group 2 or group 3, there were present also one or more carcinomata. The one case of the series in which there were growing polyps of group 3, but in which there was no outright carcinoma, is an instance of generalized polyposis (Case 13). The tumors were discovered incidentally at examination made routinely and before the inevitable development of carcinoma had attracted attention to this precancerous soil. One has only to be reminded of the similar instance of polyposis in Case 1 to realize the fate that surely awaited these polyps of group 2 and group 3, had not the growth of the tumors been cut short by extirpation of the entire colon. It is

to be noted at this point, too, that in the one case in which polyps of group 1 predominated, carcinoma was not found.

It would be likewise valueless to attempt to determine the separate ratios of carcinomata to proliferations of group 2 and group 3. It is much more useful to bracket these two groups together. Although carcinoma undoubtedly arises in greater proportional frequency and more surely in polyps of group 3, that very fact tends at once to destroy the evidence of such development. Unless the specimen is resected early in the course of the carcinomatous growth, these minute polyps, none of which exceeds 6 millimeters in diameter in size, will be completely overgrown and their part in the genesis of the carcinoma thus concealed. Consequently, we find many more polyps of group 2 bearing carcinomatous growth than those of group 3. But it is always in polyps of group 3 that we find the tiniest carcinomatous growths. And it must be remembered, too, that group 2 is numerically the largest and into it fall most of the polyps. Polyps of group 1 are too slow in their growth ever to become important as centers of carcinoma, and polyps of group 3 are too early overtaken by carcinomatous change to retain long their status as polyps.

Metastasis. Any consideration of multiple carcinomata, especially multiple carcinomata of the same order and grade and in the same organ, must reach sooner or later the problem of metastasis. Without serial sections of all of these specimens, including the whole of the colon in Case 1, it could not be denied absolutely that some of these carcinomata are the metastatic expression of some of the others. But reasonable certainty in the matter demands no such impossible proof. We have shown for the 24 carcinomata in this series that the sites of origin of the carcinomata are in polyps and not elsewhere. The literature is full of instances of carcinoma occurring in polyps in various persons. If, then, one polyp in a field becomes carcinomatous under whatever influence is operative there, other polyps in the same field are just as likely to experience the same change. Furthermore, in the examination of the hundreds of tumors in these specimens, no evidence was uncovered to indicate that metastasis accounted for any of the carcinomata. It is true that numerous polyps in the mucosa in the neighborhoods of rapidly growing carcinomata are to be seen on the point of being invaded and destroyed. But the involvement of the polyps in this manner is by direct extension and not by metastasis. If, for instance, in Case 1, metastasis were to account for any one of the four carcinomatous centers obtaining there, one would have to argue that such metastasis took place only from polyp to polyp and that the intervening mucosa, submucosa, and stalks were in some manner miraculously exempt from the workings of the phenomenon. This, indeed, leads to absurdity, but it comprises about all the support that can be mustered to place these multicentric regions of cancerous change on a basis of metastasis.

Recurrence. Recurrence is a commonplace of surgical procedures or of carcinoma. But in carcinoma of the colon, especially of its left side, recurrence may not be recurrence at all. Unless all of the polyp-bearing mucosa of the organ is removed at the time of operation, other of these tumors thus left to grow may well work out their destiny in carcinomatous change. Particularly is this true of the older type of operation of inguinal colostomy and posterior resection. In abdominoperineal section, more of the untrustworthy fields of polyp of the colon are removed and the possibility of both genuine and spurious recurrence is definitely reduced.

Schultze pictures. In examining microscopic specimens of the colon, one notices with surprising frequency points at which the mucosa seemingly dips down deep into the submucosa, forming a crypt. Longitudinal sections at these points give rise to the impression that an invasive process of epithelial proliferation is under way. These invasions may be numerous in one specimen and entirely absent in many others, a fact that once helped to bring the growths under surveillance as suspicious processes in the histogenesis of carcinoma of the colon. In 1905, Walter Schultze traced the development of such processes not only in colons of adult persons but also in the large bowls of infants and embryos. Later he examined the intestines of many animals, both of the familiar domestic species and of a great variety of the zoological orders found in the menageries of Berlin and other German cities. It was his conclusion that the process is widespread in both man and beast and that although the heterotopic epithelium establishes its position by invasive action, the resulting formations are, nevertheless, normal in structure and intent, and never carcinomatous. The development of these processes, since called Schultze pictures, is secondary to the rupture of an inflamed mucosal or submucosal lymph follicle. The sinus tract thus formed is quickly healed by the downgrowth of units of mucous membrane.

In Figures 17a and 17b, the development of these pictures is shown in its various steps and in varying degrees of magnification. It is to be noted that the normal epithelium and not the epithelium of the polyp is here involved. In Figure 13, this selective action of the mucosa is even more strikingly shown. In this instance the overlying epithelium is either of a carcinomatous or polyp order, yet the Schultze picture is formed from normal mucous membrane. It cannot be said, of course, in this case that the upward and downward proliferations were simultaneous. It is to be noted, too, that in none of these regenerative centers has the newly formed epithelium exceeded the boundaries of the injured lymph follicle. Thus there is in these Schultze pictures pointed evidence that hyperplastic proliferation in the intestinal mucosa may be reparative and useful. It is only when these proliferations occur from unknown cause and at useless times and places that there are developed precancerous formations.

The cell, cancerous and precancerous. In the accounts of pathological changes the epithelial elements of the polyps of group 2 were repeatedly described as being composed of single-layered, enlarged cells, tightly compressed into columnar forms, showing blunt, rod-shaped, deeply staining nuclei and the marks of sharply diminished production of mucus. This polyp epithelium is easily distinguished by these characteristics from the epithelium of normal mucous membrane. The distinction between normal epithelium and that of polyps of group 3 was shown to be even more striking. In the polyps of this group, the cells proliferate in multilayered cords and alveoli; their shape and that of the nuclei tend more and more to vesicular, roughly spherical forms, the production of mucus is practically abandoned, and numerous subsidiary nucleoli and mitotic figures appear. This description of polyp cells is, indeed, directly applicable to carcinomatous units. If there is a morphologic distinction between the two forms at practical magnifications, the line of such distinction is extremely fine and exceedingly devious. It is as a matter of fact by means of arrangements of glandular tubules and disposition of connective tissue that we separate the two forms of growth, and thus, for polyps of group 3 such epithelial proliferations approaching so closely in form and behavior to outright carcinoma must be regarded as definitely precancerous, and must be so treated.

SUMMARY AND CONCLUSIONS

The foregoing histological studies were based on 13 cases of polyposis of the colon. Two of these cases were instances of generalized involvement of the lower part of the bowel and should be added to the 127 other reports in the literature of this uncommon form of extensive proliferative disease of the large intestine.

The arguments of this study supported by histological evidence could be briefly summarized in this manner:

1. Characteristic structural variations in polyps of the large intestine serve as readily recognizable criteria for the classification of the growths into three major groups, each of which not only presents pathological unity, but also and more importantly, follows a definite predictable clinical course.

2. Of the three groups, group 1 alone is entitled to the benign implications remaining in the name polyp; group 2 tends inevitably in time to malignant change, and group 3 is an immediate precancerous formation.

3. The three-phase plan of classification, as outlined here, is a convenient refinement in pathological descriptive practice, and a useful clinical guide to operation and prognosis.

4. The site of origin of 22 of the 24 carcinomata in this series was traced back through unbroken lines to polyps. The genealogical evidence for these growths, and that to be found in the literature for other similar carcinomata, argue persuasively for the extremely plausible contention that the histogenesis of carcinoma of the colon is mediated through precancerous polyp formations and not otherwise.

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SECONDARY PLASTIC REPAIR OF THE COMMON DUCT

A New Aid in Finding the Proximal Stump[1]

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MUCH has been written and said concerning methods for the repair of bile ducts injured at operation. While the technical problems involved in restoring continuity are extensively dealt with, little mention is made of the difficulties encountered in identifying and isolating the injured structures before plastic procedures may be undertaken. The attempt to secure adequate exposure may involve a long and trying dissection in patients by no means prepared to withstand the trauma and shock of extensive surgery. Not infrequently the attempt must be abandoned before both ends of the severed duct have been secured. Measures designed to hasten and facilitate exposure of either cut end should therefore be most welcome.

The approach to the proximal stump of a severed duct is usually made along the tract of the biliary fistula which has been allowed to form. The course of this tract may be marked in suitable cases by the injection into it of a dye, such as methylene blue, which stains its lining, or by the introduction of probes or catheters. Unfortunately, these maneuvers do not always guide the surgeon accurately to the very mouth of the injured duct. It is true that this opening is usually patent and pouring forth bile. But this is liver bile—thin, lemon yellow, often scanty, recognizable on gauze sponges, but readily obscured by oozing, and scarcely standing out against the color of the tissues. It would seem desirable to alter the bile escaping from the open end of the duct in such a way as to facilitate the detection of its source.

The color of the bile may easily be altered by the systemic administration of various dyes excreted more or less selectively by the liver. This alteration in color has been made the basis for a method of estimating liver function, the rapidity and degree of elimination of the dye employed being measured on aspirated specimens of duodenal content. The use of indigocarmine for this purpose was initiated independently by Hatiéganu and Lepehne, and further clinical work with this dye in determining liver function has been reported by Einhorn and Laporte, Bossert and Loers, and Kusznezow. A study of the literature and preliminary experiments on animals led to the adoption of indigocarmine for the purpose here described.[2] This choice was based on the availability of the substance, its lack of toxicity, the promptness and directness with which it produces the desired change in color, and the sharpness with which the blue green color produced stands out against the tissues.

In the following case, indigocarmine was given intravenously to facilitate the localization of the proximal stump of a severed common duct. The procedure was of such distinct help that it is deemed advisable to record the results at this time.

Mrs. E. K., 62 years old, entered the Passavant Memorial Hospital on the service of H. M. Richter on April 4, 1930. She stated that she began to have attacks of abdominal distress about 10 years previously. In March, 1929, she was operated upon elsewhere, her gall bladder and appendix being removed. The gall bladder contained no stones. Because of a persistent biliary fistula, a second operation was performed 2 weeks later. It is not known what was done at that time. After 2½ weeks the fistula closed. There was no further trouble until June, 1929, when she developed pain in the region of her wound and her temperature rose to 103 degrees F., after which the fistula reopened, drained for 10 days, and closed. During the following months there were no symptoms except for frequent transient attacks of fever and malaise. In September, 1929, jaundice was first noted by a physician. This gradually deepened. On April 4, 1930, when she entered the Passavant Hospital, she complained only of jaundice and weakness. Her weight had fallen from 125 to 78 pounds. On examination the skin, oral mucosæ and scleræ were deeply jaundiced. There was a surgical scar 10 centimeters long in the right upper quadrant. The liver was smooth and firm, palpated 6 to 7 centimeters below the costal region. There was no abdominal tenderness or rigidity. The stools were clay colored and contained no bile. There was much bile in the urine. On April 7, 1930, a quantitative van den Bergh showed 4.0 milligrams per 100 cubic centimeters of serum. On April 8, 1930, an exploratory laparotomy was performed. There were most extensive adhesions between stomach, duodenum, liver, and anterior abdominal wall. The liver was hard and irregular. After a long and difficult separation of adhesions, particularly those extending between liver and duodenum, the distal portion of a severed common duct was isolated. Further search disclosed the bed of the gall bladder and a large amount of scar tissue, but repeated probings and aspirations failed to reveal the proximal stump of the duct. Because of the patient's general condition (systolic

[1]From the surgical service of H. M. Richter., M.D.

[2]The experimental work was performed several years ago when the writer was a Baer Fellow in Pathology at the Nelson Morris Institute for Medical Research of the Michael Reese Hospital, Chicago.

blood pressure had fallen to 70), it was deemed unwise to continue the search. A black silk marker was sutured into the distal stump, a cigarette drain was inserted in the hope that a fistula might form, and the wound was closed. The blood pressure rose steadily and in several hours had returned to normal. On the following day there was a profuse bile-stained drainage from the wound. This drainage persisted, and simultaneously the jaundice decreased in intensity, so that by May 10, the quantitative van den Bergh had fallen to 1 to 5 milligrams per 100 cubic centimeters. On May 5, a trial intravenous injection of 5 cubic centimeters of indigocarmine was made. A change in the color of the fistula bile was noted 10 minutes later. This change gradually became more pronounced in nine consecutive specimens collected at 5 minute intervals.

The medical management of the case was supervised by Dr. Paul Starr. On a high carbohydrate and low fat diet, and with repeated blood transfusions, intravenous injections of glucose and oral administration of her own fistula bile, the patient's general condition gradually improved.

Several days previous to the final operation the catheter which had been inserted into the biliary fistula slipped out, and could not be replaced.

On June 5, 1930, a laparotomy was again performed. The peritoneum was found to be obliterated by dense adhesions through which the course of the fistula could not be accurately traced. Immediately after the induction of anæsthesia, two ampoules (10 cubic centimeters of an 0.8 per cent solution) of indigocarmine were injected intravenously. After some difficulty the distal stump of the common duct was located by means of the black silk which had been sutured in at the previous operation. Search was then instituted for the proximal stump. Pale yellow bile in small quantities was escaping into the field, but its source could not be ascertained. As the work progressed, however, the bile rapidly grew darker, finally becoming a distinct bluish-green. With this change, the source of flow was promptly determined. The adjacent tissues were not stained. The orifices of both stumps were dilated with sounds, and a catheter was passed through the distal stump into the duodenum. The proximal end of the catheter was then passed through the proximal segment into the liver, and the ends were united as snugly as possible over the catheter. A free omental graft was tucked in about the line of suture, two cigarette drains were inserted, and the wound closed. The patient made an uneventful recovery. At the end of a week, no bile had discharged from the wound, the stools contained large quantities of bile, and a quantitative van den Bergh was less than 0.7 milligrams per 100 cubic centimeters.

The amount of dye here used appeared to be adequate. In the presence of serious hepatic damage larger doses may be necessary and can be given with perfect safety. The harmlessness of this substance was emphasized by Chrzonszczewsky and again by Voelcker. A frog, into whose lymph sac 1 or 2 grams of the pure dye have been introduced, turns a deep blue, but lives on unperturbed. Alleged toxic effects from its intravenous administration having in all probability been due to the use of too concentrated and, therefore, incompletely dissolved preparations (Peterson).

The time of first appearance and maximum concentration of the dye in the bile after intravenous administration may vary considerably. Curves of excretion under normal and pathological conditions, as determined in specimens of duodenal content, have recently been constructed by Kusznezow. Excretion in normal individuals, according to this author, usually begins in 18 to 25 minutes, and continues for from 55 minutes to 2 hours and 20 minutes. The maximum concentration is usually reached about in the middle of the excretion period. A preliminary trial, collecting 10 minute specimens of fistula bile after injection of the dye, should determine the dosage in each case.

Another possible use for the procedure here described suggests itself. It has been advanced as an argument against closure of the abdomen without drainage after cholecystectomy or common duct operations that minor damage to the principle bile ducts, the division of small accessory ducts, an imperfectly tied cystic duct ligature, or an incompetent suture line in the common duct may allow an escape of bile not readily noticeable at the time of operation, but subsequently resulting in a slow extravasation into the peritoneal cavity. It is conceivable that the previous administration of indigocarmine might materially aid in the detection of such leakages. The suggestion is made that it be given routinely in all cases in which difficult surgery of the biliary passages is anticipated.

CONCLUSIONS

1. Exposure of injured bile ducts is frequently more difficult than their plastic repair.

2. Indigocarmine, injected in adequate amounts intravenously, is excreted in the bile, stains it bluish-green, and may aid in guiding the way to the proximal stump.

3. A similar procedure may be of value in detecting leakages of bile before closure of the abdomen following cholecystectomy and common duct operations.

I am greatly indebted to Dr. H. M. Richter for the opportunity of applying the method described in the present case.

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TEMPORARY PARALYSIS OF THE RECURRENT LARYNGEAL NERVES FOLLOWING THYROIDECTOMY

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OF ALL the accidents peculiar to surgery of the thyroid gland, injury to one or both of the recurrent laryngeal nerves is a most serious complication. Most injuries of the recurrent laryngeal nerves undoubtedly occur because of the unfamiliarity of the surgeon with their true anatomic position. Opinions, however, differ considerably as to the normal position of the nerves, one investigator stating that the nerve lies directly in the tracheo-œsophageal groove, while a second reports that the nerve occupies a more lateral position.

Higgins, in a study of the surgical anatomy of the recurrent laryngeal nerves, found that on the right side the nerve arises in front of the subclavian artery, passes around the artery, and then obliquely upward to the side of the trachea and passes behind the inferior thyroid artery ascending in the tracheo-œsophageal groove. About three quarters of an inch before it enters the larynx it divides into two constant fibers. On the left side it passes over the arch of the aorta, then winds around the arch just laterally to the ligamentum arteriosum, and passes upward along the tracheo-œsophageal groove. In the tracheal region the right nerve lies farther to the front than does the left.

Berlin and Lahey, in 22 dissections in animals, showed that in 18 the nerve on the right side was anterior to the inferior thyroid artery. In the 4 remaining cases the inferior thyroid artery was anterior to the recurrent laryngeal nerve. On the left side, the artery was anterior to the nerve in 19 dissections, in 3 the inferior thyroid artery was posterior to the nerve. As to the relative position of the nerves and the trachea, it was observed that they both run in the tracheo-œsophageal sulcus, with the left nerve often appearing a little deeper in the sulcus than does the right.

Fowler and Hanson, dissecting 200 cadavers found that the recurrent laryngeal nerve, in the region of the lower pole of the thyroid gland, lay 1 to 2 centimeters lateral to the trachea. In 262 cases (65.5 per cent of 400), the nerve passed posterior to the main branches of the inferior thyroid artery. In 104 cases (26 per cent) the nerve passed anterior, while in 34 cases (8.5 per cent) the nerve ran between the main branches of the inferior thyroid artery. In the majority of cases, the most intimate relation between the gland and the nerve was not at the lower pole as is generally assumed, but rather on the posterolateral surface at the junction of the middle and lower thirds.

Recently, Crile aptly said, "It is not its anatomic location, however, but rather the vulnerability of its structure, the neighborhood changes of fixation and adhesions, and certain characteristics of the nerve conduction, which form the hazards. The slightest direct, or even indirect, pressure on the recurrent nerves, interferes with nerve conduction and immediately changes the voice. By contrast, the peripheral nerve fibers can undergo much trauma without resultant motor or sensory disturbance, but the naked recurrent nerve is almost as sensitive as is the naked brain, or the spinal cord. Struggle and survival probably have not influenced such vital organs as the larynx and trachea which have always demanded complete protection, the alternative being death. Whatever the cause, these nerves are exceedingly sensitive, exceedingly delicate, and the action current through them is easily blocked. In their vulnerability the recurrent nerves must be classed with the brain, the spinal cord, the optic, the auditory and the splanchnic nerves; the exceeding vulnerability of the recurrent nerve is, therefore,

the first and most important factor in the production of abductor paralysis."

Judd, New and Mann, studying the effect of trauma upon the laryngeal nerves, made some interesting observations. These investigators traumatized laryngeal nerves in a manner similar to that which occur in an operation and subsequently studied the function of the vocal cords. When the nerve was pinched once with a hæmostat at various points, there was in every instance a paralysis of the cord supplied by the pinched nerve. In every instance, however, in animals living long enough, there was complete restoration of the function of the cord, varying in time from 30 to 60 days.

Ligation of the nerve invariably produced a complete paralysis which in every instance was permanent. Section of the nerve always produced a complete and permanent paralysis of the cord or cords innervated.

Traction by putting hæmostats under nerves for from 10 to 30 minutes caused no disturbance of the vocal cords. Stretching the recurrent laryngeal nerves acutely in a manner similar but of longer duration and intensity than occurs at operation resulted in no impairment of function of the cord. Stretching the nerve for a long period, as over muscles, impaired the vocal cords, but these investigators concluded that this was probably due to operative trauma and not to stretching.

Crile, however, disagrees with these investigators as to the effect of stretching on the nerve. He feels that the most common direct cause of abductor paralysis is due to the pull on the nerve which may occur when the goiter is rolled out. He says: "The most disastrous effect is produced when the nerve is disturbed by the dislodgement by the finger of an upper lobe which has thrust itself behind the larynx. Such a direct pressure and pull on the laryngeal nerves have probably caused more paralyses than either forceps or knife." He is of the opinion that any pull on the nerve may cause partial and temporary, or complete and permanent paralysis, and concludes that abductor paralysis is probably most frequently caused by traction.

That traction can produce paralysis of the recurrent laryngeal nerve was demonstrated forcefully recently by the following case operated upon by one of my colleagues.

CASE 1. The patient was operated April 15, 1930, for thyrotoxicosis. After the removal of the left lobe a bleeding vessel in the tracheo-œsophageal area was clamped without incident. At the completion of the operation the voice was normal and there was no respiratory embarrassment. The following day, however, there were definite signs of respiratory embarrassment associated with some cyanosis. An examination of the larynx revealed a paralysis of the left vocal cord. The mobility of the right cord was reported as "sluggish." The cyanosis continued and a few days later definite signs of pneumonia were evident, the patient dying April 20, 1930. At the autopsy the site of operation was explored. Carefully dissecting the left recurrent laryngeal nerve, it was found that a ligature which had been placed around the inferior thyroid artery caused an acute angulation of the nerve. The nerve itself was free except for the acute angle produced by the ligature which had been placed to control the inferior vessel. Had this patient lived it is safe to say the paralysis would have been only temporary.

Pressure from a hæmatoma can also bring about a temporary paralysis of one or both nerves. Recently such a case came under my observation.

CASE 2. The patient was operated for thyrotoxicosis April 1, 1930, the procedure being carried out almost entirely under local anæsthesia, the patient being made to talk throughout the greater part of the operation. The gland was small, very firm, friable, and bled profusely. At the completion of the operation a pack was inserted. The voice at all times remained unchanged. Forty-eight hours later the packs were removed. The next morning a swelling was noted on the left side which undoubtedly was a hæmatoma which appeared following the removal of the pack. It was deemed advisable to evacuate the hæmatoma, but under no consideration would the patient or family permit of such a procedure. The following day hoarseness was noted and on laryngoscopic examination the left cord moved slightly. The next day the hoarseness was more marked and a complete paralysis of the cord was found. As the hæmatoma absorbed, the hoarseness became less marked and function of the cord gradually returned. At the end of 4 weeks the voice was normal, and the cord functioned normally.

Œdema following thyroidectomy undoubtedly is frequently the cause of temporary postoperative paralysis. As the tissues swell, pressure is exerted upon the nerves resulting in a hoarseness and either a partial or complete temporary paralysis. Hoarseness and paralysis coming on 12 hours or more after thyroidectomy, the voice prior and immediately after operation having been normal, can best be explained by œdema of the tissues. Manipulation around the inferior constrictors of the larynx and pressure on the posterolateral tissues of the gland itself may result in excessive reaction with subsequent œdema and impairment of the nerves.

Permanent bilateral recurrent nerve damage is a catastrophe, having few equals in the realm of surgery. Injury to both nerves is associated with early obstructive dyspnœa, and complete loss of voice. Examination of the larynx early, following such an accident, usually reveals the cords in the cadaveric position (half way between adduction and abduction) thereby narrowing the breathing space. Because of the inability to approximate the cords there is a complete loss of voice. Soon the cords occupy the midline position further

narrowing the breathing space, and is accompanied by obstructive dyspnœa, appearing at first after slight exertion, but soon becoming progressively worse until the patient cannot at any time breath easily, requiring a tracheotomy for relief. The voice, following such an injury, according to Pemberton, usually returns in 3 to 6 months, but almost invariably accompanying the return of phonation, obstructive dyspnœa becomes prominent.

Bilateral temporary recurrent nerve paralysis is occasionally encountered. It may come on during the course of an operation, either from stretching of the nerves while mobilizing the gland, by pinching the nerves with a hæmostat, from finger pressure on the nerves; or it may come on later (from 1 to 3 days or even later) as a result of œdema of the structures about the nerves, from hæmorrhage about the nerves exerting pressure on them, or as a result of an accumulation of serum causing pressure on the nerves.

CASE 3. This patient was operated upon September 5, 1929, for a high grade hyperthyroidism. At operation a large and extremely firm gland was found. Toward the end of the operation the patient manifested marked inspiratory dyspnœa. An attempt was made to locate the nerve in the field of operation but this was not successful. The dyspnœa continued, and the voice was reduced to a whisper. The next morning because of continued dyspnœa, cyanosis, choking and coughing, a tracheotomy was performed—30 hours after the operation.

Laryngoscopic examination revealed immobility of both vocal cords. Seven days later the tracheotomy tube was removed with the idea of replacing it with a smaller one. The patient, after the tube had been removed, was so comfortable that it was deemed inadvisable to replace it. An examination of the larynx at this time showed a complete paralysis of the left cord, while the right cord showed some fluttering. Seven days later the laryngologist reported, "cords in cadaveric position. Some movement of the right arytenoid on forced phonation, but none on left." The voice gradually improved and on October 18, 1929, the laryngologist reported as follows: "Both cords functioning, almost full movement on right with great improvement on left." One month later, November 15, 1929, the voice was normal and both cords were reported as functioning normally.

CASE 4. Patient was operated October 4, 1928, because of a high grade thyrotoxicosis. The gland was very friable and bled profusely. The voice at the completion of the operation and for the first 18 hours was normal. Gradually she became increasingly hoarse with some inspiratory dyspnœa. Examination of the cords the day after the operation showed a paralysis of the left cord with considerable œdema of the right cord which moved only slightly on forced phonation. One month later the voice was very high pitched and the cords were found in the cadaveric position. There was considerable inspiratory dyspnœa especially on exertion. Gradually the dyspnœa disappeared, the voice became stronger and 13 months after the operation, the voice was normal, and both cords moved normally.

CASE 5. Patient was operated March 3, 1923, for hyperthyroidism. Marked dyspnœa developed after patient began to recover consciousness and examination of the larynx revealed a paralysis of both cords. The dyspnœa gradually lessened, the voice became stronger and on November 23, 1923, an examination of the larynx revealed an actively functioning right cord. The left cord was still immobile. The patient was lost track of until April 17, 1926, 3 years later, when an examination of the larynx revealed both cords functioning normally. The voice was normal and there was no respiratory embarrassment.

CASE 6. This patient was operated for hyperthyroidism May 24, 1923, and was apparently well until December 10, 1923, when there was a return of symptoms. She was again operated April 10, 1925, at which time moderate sized masses of thyroid tissue were found on each side of the trachea. The lower portion of the right mass was clamped and cut across, just above the lower pole, and a suture ligature was placed at the site of the clamp. Immediately inspiratory dyspnœa appeared which persisted after the removal of the ligature. Examination of the larynx showed a bilateral paralysis of the vocal cords. The dyspnœa subsided and the voice gradually became stronger. This case was further complicated by a severe postoperative parathyroid tetany and bilateral cataracts which required surgical intervention. Because of the severity of the tetany and the cataracts, and owing to the fact that the voice had gradually returned to normal, no examination of the larynx was made until April 13, 1928, at which time the cords were found to be normal.

Injury to one recurrent laryngeal nerve is frequently overlooked, neither the patient nor the doctor being aware of the accident, unless an examination of the larynx is a routine procedure, at which time one cord may be found paralyzed. The opposite cord, in such instances, compensates for its paralyzed mate and the patient may recognize no change in the voice. Rankin states that 1 per cent of patients have unilateral paralysis of the vocal cords prior to operation.

Most frequently, however, when there is an injury to one nerve, a change in the voice is noted, which may vary from a slight elevation of pitch to a marked hoarseness. As a rule the voice remains changed for a number of months, becoming more and more normal, as the opposite cord takes over the entire function. At times, however, the voice remains permanently changed, never returning to its normal caliber.

Obstructive dyspnœa is, as a rule, not present when only one nerve is injured. At times, however, injury to one nerve associated with marked œdema of the larynx will result in severe obstructive dyspnœa, requiring tracheotomy.

Unilateral paralysis, of a temporary character, coming on during the course of an operation, or appearing after operation, occurs more often than is usually suspected. Such a paralysis may last from several weeks to one year or more and is usually associated with a few postoperative reactions. A change in voice is usually the only complaint.

CASE 7. This patient was operated July 3, 1925, for an adenomatous goiter with hyperthyroidism. At the completion of the operation there was no dyspnœa, and the voice was normal. The following day the patient was definitely hoarse and laryngoscopic examination revealed a paralysis of the left cord. Gradually the hoarseness subsided and on September 8, 1925, 2 months after the operation the voice was normal and both cords moved normally. This case was undoubtedly one of postoperative paralysis resulting from œdema of the tissues about the recurrent nerve, completely disappearing after 2 months.

CASE 8. Operation for severe hyperthyroidism, November 8, 1926. There was considerable difficulty in delivering the gland and while attempting to mobilize the upper pole on the left side, the patient suddenly developed inspiratory stridor which continued throughout the operation. Laryngoscopic examination showed a paralysis of the left cord. The inspiratory difficulty persisted for several days, and although the right cord was normal, the patient could not talk above a whisper. Gradually the stridor disappeared, the voice became stronger and 3 months later, February 28, 1927, the voice was perfectly normal and laryngoscopic examination revealed normal cords.

In this case the paralysis was undoubtedly the result of stretching the nerve as the upper pole was being mobilized, the paralysis disappearing after three months.

CASE 9. This patient was operated January 29, 1927, because of a high grade hyperthyroidism. There was no change in the voice until the second day after operation, at which time definite hoarseness was manifest. An examination of the larynx revealed a paralysis of the left cord. Two months later, March 11, 1927, although there still was some hoarseness, the laryngologist reported, "a paresis of the left cord, with some motion which should improve." Six months later (July 13, 1928) the voice was completely normal and both cords moved actively.

CASE 10. This patient, a woman of 68 years, was operated upon for a toxic adenoma August 19, 1927. The voice at the completion of the operation and for several days after operation was normal. On August 27, 1927, there was a note on the history stating that the patient had been hoarse for the past few days. Examination of the larynx revealed a paralysis of the right cord. On September 12, 1927, one month after operation, the laryngologist reported a lagging of the right cord. One month later, October 21, 1927, the right cord was reported as "sluggish." Ten months after the operation (June 21, 1928), the voice was perfectly normal and the laryngologist reported normal cords.

CASE 11. This patient was operated in December, 1916, for an exophthalmic goiter. She was reoperated upon September 18, 1924, because of a return of hyperthyroidism. The operation was extremely difficult, the postoperative course was extremely stormy and was associated with marked hoarseness and inspiratory difficulty. Two days later (September 20, 1924), considerable serum was evacuated with marked relief. An examination of the larynx revealed the left cord in abduction. The respiratory embarrassment as well as the voice gradually improved. An examination of the larynx 2 years later (October 24, 1926) showed actively moving cords.

CASE 12. This patient was operated January 13, 1928, for exophthalmic goiter. The gland was extremely friable and was delivered with difficulty. There was considerable bleeding, and while clamping a spurting vessel on the left side near the trachea, there was noted immediately a change in the patient's voice. The operation was completed, and an examination of the larynx revealed a paralysis of the left cord. Seven months later (August 7, 1928) although the voice had improved considerably, there was still a paralysis of the cord. On March 19, 1929, 13 months after the operation, the laryngologist reported both cords normal.

Here undoubtedly was a paralysis resulting from the crushing of the nerve while attempting to clamp a bleeding vessel near the trachea, returning to normal thirteen months after the injury.

CASE 13. This patient was operated upon January 16, 1928, for exophthalmic goiter. The voice was normal immediately after the operation and for the next 2 days, after which slight hoarseness was noted. An examination of the larynx revealed a paralysis of the left cord. One month later (February 21, 1928), the voice was normal, and an examination of the larynx revealed normally functioning vocal cords.

The paralysis, in this case, was probably due to postoperative œdema.

CASE 14. This patient gave a history of hyperthyroidism of 26 years' duration. She was operated upon December 11, 1928, without incident, the patient breathing normally, the voice remaining unchanged throughout the operative procedure. Some tracheitis developed shortly after the operation which was considerably relieved by steam inhalations. Three days after the operation, the patient became hoarse and an examination of the larynx revealed a paralysis of the right cord. Gradually the voice returned to normal and on October 28, 1929, 10 months after the operation, the cord had completely recovered.

Here is a case of temporary paralysis resulting from œdema of the tissues after operation. The voice was normal immediately after the operation, and not until the third day after operation did hoarseness develop. A severe tracheitis appearing shortly after the operation further strengthened the hypothesis that the paralysis was the result of œdema of the tissues about the nerve.

CASE 15. This patient was operated August 19, 1929, for exophthalmic goiter. The operation was uneventful and several days after operation the patient complained of some hoarseness. An examination of the larynx revealed a paralysis of the left cord. Gradually the voice returned to normal and on November 12, 1929 (3 months later) the voice was normal, and the cords were reported normal.

How can temporary or permanent paralysis of the recurrent laryngeal nerves be prevented? No definite rules can be laid down, but certain principles must be adhered to which will tend to minimize injury to these delicate structures.

1. Adequate exposure is of extreme importance. The surgeon should not hesitate to transect the ribbon muscles overlying the thyroid gland whenever there is a question as to the adequacy of the exposure.

2. It is extremely important to minimize the force used in bringing the superior thyroid vessels into view,

3. Resection of the thyroid gland should always begin at its tracheal attachments and progress laterally and downward.

4. The posteromesial portion of each lobe must be preserved, and under no circumstances must the lateral wall of the trachea be exposed.

5. The anæsthetic is of extreme importance and must be light enough so that the patient can be awake within a few minutes. Ether or chloroform should never be used. Probably the best procedure combines the use of novocain infiltration plus either nitrous oxide or ethylene.

6. One lobe at a time should be removed, and while the operator is working in the region of the recurrent laryngeal nerve, the patient should be awake and made to talk.

7. Accurate hæmostasis is of extreme importance in thyroid surgery. No patient should be permitted to leave the operating table until the operator is satisfied that he has done everything to prevent a postoperative hæmorrhage. Every patient should be made to cough or strain in order to demonstrate any overlooked open vessels.

8. Grabbing of tissue about bleeding points should be avoided. Single bleeding points must be isolated before a hæmostat is applied.

9. Rough sponging or pulling should be avoided, thus preventing excessive postoperative œdema.

10. Hæmatomata should be recognized and evacuated early.

11. Routine pre-operative laryngoscopic examination of the vocal cords is advisable, as one cord may be impaired. Such information is of importance to the surgeon, who will be particularly careful to preserve the remaining nerve.

CONCLUSION

Temporary paralysis of the recurrent laryngeal nerves is not infrequently encountered. Such a paralysis may be unilateral or bilateral, and as a rule cannot be differentiated from a permanent paralysis, time alone differentiating the type.

Temporary paralysis may come on during the operative procedure, by pinching the nerve with a hæmostat, by stretching the nerve during the mobilization of the gland, or from pressure of the nerve by the finger in attempting to control bleeding. Delayed paralysis may occur as a result of hæmorrhage with pressure on the nerve, from a collection of serum causing pressure, and from œdema of the surrounding tissues resulting from the necessary surgical trauma.

Function as a rule is restored after a variable period of time, varying from several weeks to several years depending upon the extent of the trauma.

I am indebted to Dr. John Wolfer for permission to use Case 1, and to Dr. H. M. Richter for permission to use Cases 3 to 15 inclusive.

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PYO–URETER[1]

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AT the 1910 meeting of the American Association of Genito-Urinary Surgeons, Fowler presented an article entitled "Uropyonephrosis of Only Remaining Kidney; Nephrectomy. Pyoureter of Other Side with Peristaltic Contractions of the Ureter Observed Three Years After Complete Nephrectomy."

In recently reading over his very excellent and interesting case report together with the copious discussion which followed, I was quite impressed by the fact that the discussion centered almost entirely on the first part of the title. Much was said about the difficulties of operating on a single kidney but comparatively little on the then unusual phenomenon of observed peristaltic contractions of the ureteral stump and the importance that it might play in the prognosis of the case.

So far as I have been able to ascertain, Fowler's was the first article of its kind to be written in this country and the fact that up to this time very little on the subject had appeared in the literature of any country, probably accounts for the trend of the discussion of Fowler's presentation. Since then it has become a generally accepted fact, due doubtless to the experimental work of Latchem and the clinical observations of several others, that peristaltic contractions do take place in certain ureteral stumps, notably those containing calculi, pus, or both and that such pathological rests may constitute a menace to the patient's welfare.

According to Fronstein, these rhythmical peristaltic contractions depend in part upon the presence of nerve centers which are situated either in the ureteral walls or in the surrounding connective tissue. According to Latchem, the peristaltic movements will cease when there is nothing within the ureteral lumen, such as urine, pus, or stones to stimulate the nervous mechanism to action. This explains Latchem's further experimental observation that the muscular coat of the ureter hypertrophies in the presence of complete obstruction and atrophies in the ureter wherein drainage is more or less free.

Latchem's experiments also showed that there is little or no absorption of the contents of a distended ureter.

We have briefly therefore, according to Fronstein and Latchem, the physiological reason for the development of an empyema of the ureteral stump. Given an infected ureter the corresponding kidney of which has been removed, whether or not the stump will become a pus pocket depends chiefly on two factors: (1) the presence of some obstruction, such as stone, stricture or kink; (2) injury to the nerve supply of the ureter, either by operative trauma or peri-ureteritis and consequent scar formation. When obstruction occurs, either complete or sometimes partial, dilatation and retention of pus in varying amounts are likely to ensue. When the nerve supply has been damaged, especially in a peri-ureteritis, narrowings and pockets are likely to develop due to loss of tone on the one hand and cicatrical contractions on the other.

The greatly distended ureter, present prior to nephrectomy, is of course always a potential source of pyo-ureter. But fortunately in a ureter which is anything like normal, the suppurative condition which as a rule follows a suppurative condition of the kidney, usually disappears after the removal of the diseased kidney. This is in accord with Lorin's view who says that if there is a free outlet, pus will usually drain out regardless of extensive damage to the ureter.

Stone is the chief etiological factor by far in the majority of the reported cases of non-tuberculous pyo-ureter.

Israel, who was among the first to describe the subject, collected 4 cases in 900 nephrectomies. Fronstein saw 3 during 20 years of active practice. Two of his cases were attributed to stricture and one to stone. In one of his stricture cases, there were 2 ureteral stumps, both of which he removed. One stump was 3 centimeters wide while the other was not enlarged.

In his very recent comprehensive article on the subject, Hunt reports one case of non-tuberculous pyo-ureter due to stricture and states that it is the only one he could find in a careful search of the records of the Mayo Clinic, in which ureterectomy was necessary subsequent to nephrectomy for pyonephrosis. He reports 4 other interesting cases due to stone, in one of which ureterolithotomy alone brought about a successful outcome. In the 3 other cases, ureterectomy, either partial or complete, was done.

In this same report, Hunt's figures referable to the tuberculous type of pyo-ureter are illuminating. He states: "In no instance in the series

[1] Read at a meeting of the American Association of Genito-Urinary Surgeons at French Lick Springs, Indiana, May 22, 23, and 24, 1930.

of approximately 574 cases in which nephrectomy was performed for renal tuberculosis during the years 1919 to 1928 inclusive, have I found subsequent ureterectomy recorded."

Hyman has reported 3 cases in which empyema occurred in the short remaining stumps following incomplete ureterectomy. Stone was responsible for one of these cases.

Read's case, likewise a recent one, was unique in that the empyema occurred in a ureter which had been transplanted into the bladder. Before the nephrectomy, the underlying cause of the pyuria, namely, stricture at the site of the transplantation, had begun to manifest itself.

Roedelius has reported 2 cases, one due to stone and the other to stricture.

Among other observers who have reported at least one case are the following (the etiological factor is placed in parentheses): Latchem (stone); Chabanolle (stone); Brongersma (stone); Enderlen (stricture); Bruett (stricture) and Klika (stone). In Klika's case, there were three stones in the lower end of the ureter and a groove running along the mesial side of them, through which the urine had evidently passed prior to nephrectomy.

It is noteworthy that in some of the foregoing cases, long periods of time elapsed between the nephrectomy and the development of symptoms leading to the diagnosis of pyo-ureter. Thus in the stone case of Brongersma, 23 years intervened and in the stricture case of Roedelius, 17 years. In the majority of the cases, however, 1 to 3 years was the interval.

Among the shortest intervals between nephrectomy and the appearance of symptoms indicative of pyo-ureter are those of Klika (6 weeks), one of Hunt's stone cases (6 weeks), Read's case (2 months) and Cases 3, 4, and 5 following.

The probable chief factors upon which this interval depends are the type of obstruction, the degree of infection, the amount of damage to the ureter prior to nephrectomy and the personal equation of the patient.

The principles employed in the successful treatment of pyo-ureter are directed toward:

1. The eradication of the pus pocket (complete or partial ureterectomy);
2. Establishment of better drainage (ureterolithotomy for the removal of an obstruction such as stone or enlarging the ureteral orifice by fulguration or the dilating of strictures by bougies);
3. The removal of infected ureteral contents by non-operative means (irrigation);
4. A combination of (2) and (3).

In the majority of the cases reported as cured, the method employed was ureterectomy, either complete or partial, the latter having been employed usually when a stone was present and a segment of ureter containing the stone was removed. It would seem from Hyman's experience that complete, instead of partial, removal of the ureter should be done whenever possible.

Ureterolithotomy for stone is sometimes successful, to wit one of Hunt's cases. But despite the good result in this case, he prefers complete ureterectomy.

Doubtless many cases of pyo-ureter could be prevented by proper treatment of the ureter at the time of nephrectomy. While I cannot agree entirely with Hunt, who at the time of nephrectomy makes it a practice in the ureteral stone cases to remove the ureter either entirely or a portion of it containing the stone, still much is to be said in favor of his argument. Against it, of course, is the fact that there are comparatively numerous instances in which stones that are allowed to remain in ureteral stumps do not subsequently cause trouble. But as far as the prophylactic treatment of pyo-ureter is concerned, it behooves every surgeon who contemplates removing a non-tuberculous kidney to make, wherever possible, a complete pre-operative study of the ureter as well as the kidney itself. And if confronted by ureteral findings such as stone, stricture in the presence of pus or the dilated atonic type of ureter, the idea of performing ureterectomy at the time of nephrectomy should be given very serious consideration. In this connection it is well to bear in mind that if the patient's condition will permit, ureterectomy done at the time of nephrectomy should ordinarily be much simpler than at a later period when adhesions arising from a peri-ureteritis are prone to be both dense and numerous. This is well shown by the following description of an operation recently performed by my associate, Dr. Keyes. The procedure he employed also illustrates a method of handling a pyo-ureter which is well-nigh impossible to remove.

In this patient, a 35-year-old colored woman, there were two ureters. One, draining the upper portion of the kidney which was a pyonephrotic sac, proved to be a widely dilated pyo-ureter. The other ureter drained the lower portion of the kidney which appeared to be relatively normal. "The nephrectomy was uncomplicated excepting that the widely dilated pyo-ureter was so adherent at the pelvic brim and so tense with pus that it seemed wiser to bring it to the skin for drainage rather than to attempt a complete ureterectomy and with the realization that a secondary operation would be needed. This secondary operation was performed 10 weeks after the first one. The pelvic ureter was exposed extraperitoneally but everything was so densely adherent in the right side of the pelvis that it was necessary first to open the peritoneum and remove

the adherent tube and ovary on that side, then to lift up the peritoneum from the posterior pelvic wall mesial to the ureter and close the peritoneum.

"It was then found that the ureter was a dilated and convoluted tube set in a mass of dense adhesions. At no place could a line of cleavage be found. It was deemed unsafe to attempt complete ureterectomy so the mass of adhesions was split open and the incision carried into the coils of ureter from which thick, stinking pus escaped (bacillus pyocyaneus). Even excision of the mucosa was found impracticable, so the whole interior of the ureter was well cauterized with the high frequency current, a No. 22 F. urethral catheter sutured into the lowest loop right against the bladder and another tube inserted above.

"The accessory ureter was not looked for or discovered.

"After operation drainage was extremely profuse. Potassium permanganate irrigations were done at first every hour during the day and finally the patient left the hospital with a small tube, 1 month after operation. Curiously enough the only postoperative complication was the distress she suffered from the pressure of one of the silkworm skin sutures.

"Up to the time of leaving the hospital it was impracticable to use Dakin's solution for irrigation because the solution caused bladder irritation. It is hoped that Dakin's solution may shortly be practicable and may occasion the healing of the wound."

While the purpose of this paper is to deal chiefly with the non-tuberculous pyo-ureter, reference is made to the tuberculous type merely to emphasize again its relative scarcity.

Approximately 222 nephrectomies have been performed on the Bellevue Urological Service during the years 1916 to 1929 inclusive. This particular interval was chosen because 1916 represents the beginning of the present Urological Service, that is, the time when the individual urological services of the four different divisions of the hospital were consolidated. The total number represents all the nephrectomies performed during this period for whatever purpose nephrectomy was indicated. Of the 222 nephrectomies, tuberculosis was the etiological factor in about 98 cases. Of this number a subsequent ureterectomy was performed in only one, and even in this instance the operation was probably needless as will be shown in Case 1. The tuberculous cases reported herewith illustrate the fate of the ureter which remains after the removal of a tuberculous kidney, and are in accord with the usual observations, namely, that such a ureter takes care of itself and gives rise to trouble only in rare instances. Legueu, while performing a hysterectomy 3 years after a nephrectomy for tuberculosis, found the ureter to be a dense sclerotic cord. Lorin, in examining a series of patients wherein the postoperative course was longer, found obliteration of the ureter.

CASE 1. The tuberculous right kidney of a 15-year-old Italian girl was removed in Bellevue March 29, 1926. Her pre-operative symptoms of dysuria, instead of becoming better, became steadily worse despite various bladder treatments. Several cystoscopic examinations, made at intervals of 1 to 6 months, all showed marked inflammation and œdema in the region of the right ureteral orifice. Finally ureterectomy was decided upon as a possible means of relieving the patient. This was done on February 24, 1927. The patient was not relieved, however, until the other ureter was transplanted into the bowel (May 21, 1929). This was undertaken in the full realization that it was a hazardous procedure but the patient was becoming desperate. The transplantation accomplished results. Since this operation the patient has put on weight, is in fine spirits, and of course no longer suffers from dysuria.

Apparently the only good that came of removing the ureteral stump was to show the operator what usually happens in such a case. *Very hard and as large as one's thumb at the time of nephrectomy, the ureter had now dwindled down to the size of a lead pencil.* When split longitudinally, the wall had a grayish œdematous appearance which in places was yellowish. No muscle tissue could be recognized. The pathologist's report was tuberculous ureteritis.

The data for the second case was kindly furnished to me by my colleague, Dr. A. R. Stevens, from his private practice. The findings in so far as the tuberculous ureter was concerned, were similar to those of Case 1.

CASE 2. It was found, during the postoperative course of a 13-year-old boy on whom he had performed a suprapubic cystotomy for calculi and a little later a perineal section for an abscess behind the bladder, that the left kidney was also probably the seat of trouble. A left nephrectomy was performed and the kidney shown to be tuberculous. The ureter was as large as one's little finger and stony hard but no attempt was made to remove it on account of the patient's weakened condition.

Seven months after the nephrectomy, it was decided to do a ureterectomy because it was thought that the kidney and bladder wound which had not yet healed would be favorably influenced thereby. On performing the ureterectomy, the operator was surprised to find the ureter *soft and pliable and about the size of a lead pencil.* The patient remained in the hospital for over a year but ultimately the perineal and kidney wounds healed entirely. The suprapubic wound did not fare quite so well although when the patient was last seen in 1929, he reported that it remained closed most of the time.

Of the remaining non-tuberculous nephrectomies, approximately 124, a record of subsequent removal of the ureter on account of symptoms referable to it, could be found in only 2 of them. However, it should be mentioned that in recently discussing the incidence of the Bellevue pyo-ureter cases with Dr. Keyes, he told me he had seen in another clinic, a man whose kidney had been removed at Bellevue. This patient was between 20 and 30 years of age and while the nephrectomy had been performed more than a year previously, he was still suffering from the

same symptoms for which his kidney had been removed. Examination revealed a dilated ureteral stump.

If this be added to the 2 other Bellevue cases, it makes the Bellevue incidence somewhat higher than that reported from other clinics with the possible exception of the cases reported by Hunt.

The following cases of non-tuberculous pyo-ureter are typical and illustrate points brought out in the foregoing. Two of them were due to stones and one to a narrowing of the lower end of the ureter.

Case 3 illustrates the difficulty in attempting to single out the type of ureteral stone which will not give rise to trouble following nephrectomy. It shows also how brief may be the interval between nephrectomy and the appearance of the pyo-ureter. It is of further interest because there was a "Y" ureter, one branch only of which (the one containing the stones) was dilated but both branches of which were the seat of a definite ureteritis cystica. While, strictly speaking, the operation performed was a partial ureterectomy, so little of the ureter was left (not over 1.5 centimeters) that the procedure could almost be classed as a complete ureterectomy.

Case 3. This patient, E. B., admitted to the Urological Service of Bellevue Hospital, April 1, 1926, complained of pain in the right loin. For 19 years he had experienced intermittent burning on urination. While in the army in 1919 a diagnosis of renal calculus of the right kidney was made. Nephrotomy was performed but no stone was found. About three months after that, however, he passed a stone about the size of a pea. Since that time, that is, since 1919, his burning on urination persisted and he had attacks of pain in the right loin radiating down to the right testicle. He has not suffered from increased frequency of urination. He brought with him to the hospital a very good X-ray film showing a fairly large calculus which appeared to be in the pelvis of the right kidney and several small calculi apparently in the right ureter low down.

Catheterized ureteral specimens showed the function of the right kidney to be very poor as evidenced by the indigocarmin and urea tests. The function of the left kidney was apparently excellent as evinced by the same two methods.

It was decided that the best plan of operative procedure would be first to remove the stone from the right kidney and then at the same sitting to remove the ureteral calculi through a Gibson incision, provided the kidney operation had not taken too long and the patient's condition would warrant proceeding with the ureterotomy.

On April 6, 5 days after admission, the right kidney was exposed by means of the usual oblique loin incision. Somewhat to our surprise the kidney was found to be less than half the normal size and the remaining parenchyma was almost nil. The kidney, stone and all, was removed without any further investigation. An interesting feature of this operation was the finding of a structure which resembled a supernumerary ureter but it was so tangled up in a mass of adhesions that it was almost impossible to identify the structure with certainty.

Since the kidney itself had been removed instead of the kidney stone only, as at first intended, the plan of removing the ureteral calculi was abandoned. *It was argued they would probably never give rise to further trouble and that the patient would therefore be spared the necessity of an additional operation.*

The patient made an uneventful recovery and was discharged from the hospital on April 29, 1926, in excellent condition and with no urinary symptoms. But realizing the possibility of further trouble, he was advised to report back to the hospital should any of his old symptoms return.

On July 8, scarcely more than 2 months after his discharge, he was re-admitted to the Urological Service with symptoms of marked dysuria. He stated that he had been free from urinary symptoms for 1 month after leaving the hospital but since then had suffered from very marked increased frequency of urination, voiding every half hour by day and once or twice at night with considerable pain and burning. These symptoms had become much aggravated about 10 days before his re-admission.

The patient was cystoscoped by the resident urologist, who passed a radiographic catheter up the stump of the right ureter. The resulting X-ray did not prove to our entire satisfaction that the shadows noted in the lower ureteral region at the time of his previous sojourn in the hospital were shadows of calculi. There was too much space between the supposed stone shadows and the catheter shadow.

In reading over the account of his previous operation at Bellevue, it was noted that there was some question as to the presence of a double ureter on this side. A few days later, with this in mind, the patient was again cystoscoped and a diligent search for a second ureteral orifice was made but none found. Remembering the possibility of a Y shaped ureter with the bifurcation low down, two radiographic catheters were passed into the only ureteral orifice which could be found hoping that if such a condition existed each catheter might find its way into a separate branch of the Y. The X-ray film with these catheters in place was not particularly useful in proving our point, and it was not until an X-ray film was made after sodium iodide was injected up both catheters that it was believed we were dealing with a dilated ureter containing calculi and possibly a second ureter.

While the patient was still on the cystoscopic table a sterile solution of indigocarmin was injected up one of the catheters and immediately quite a quantity of fairly thick pus was seen to exude from the ureteral orifice alongside of the catheter. The specimen collected from the left kidney showed it to be in apparently very good condition.

A diagnosis of pyo-ureter of the remaining stump with the probable presence of ureteral calculi was made and operation again decided upon. On July 13, 1926, through a Gibson incision, we found the remains of a Y shaped ureter with the bifurcation, as near as we could tell, within one inch of the bladder. In one branch of the Y were three stones corresponding to the shadows seen in the plates. The operation presented no especial difficulties. Both ureters were removed to a point just below the bifurcation. This left only about 1.5 centimeters of the single stump. The patient again made an uneventful recovery and left the hospital about 4 weeks later with none of the symptoms which he presented on admission. He was last seen about a year after his second operation and reported no return of symptoms up to that time.

The next case (4) was treated by means of partial ureterectomy. The portion of the ureter resected included the cause of obstruction, namely,

a large stone. While the immediate result was satisfactory, we were unfortunately left in some doubt as to the final outcome.

CASE 4. On March 29, 1921, A. M. was admitted to one of the general surgical services of Bellevue Hospital, soon after he had been caught between the radiator of one automobile and the rear end of another which was backing. A left pyonephrosis developed and the kidney was removed May 21, 1921. He was discharged on July 12, 1921, and re-admitted June 6, 1922 (this time to the Urological Service), on account of severe pain in the left inguinal region which radiated down to the penis. A considerable amount of pus was found in the bladder urine. Cystoscopy revealed normal urine from the right kidney and a catheter could be introduced up the left ureter for only 1 centimeter. Nothing was obtained through the catheter and nothing was seen to emanate from the ureteral orifice. The bladder mucosa appeared to be perfectly normal and this fact, coupled with the finding of pus in the bladder urine and normal urine from the right kidney, led to the conclusion that the pus probably came from the left ureteral stump. However, since his symptoms disappeared soon after the cystoscopy, the patient was discharged on June 25, 1922.

On July 11, 1922, he was re-admitted again for pain in the left lower quadrant and an X-ray film showed a stone measuring 2 by 5 centimeters near the lower end of the left ureter, but his symptoms again disappeared and he was discharged at his own risk.

On August 4, 1922, the patient was admitted for the fourth consecutive time to Bellevue. On this occasion the pain in his left loin and left lower quadrant was so severe that he did not hesitate to agree to an operation. His only other symptoms were increased frequency of urination.

On August 25, the following day, through a somewhat modified Gibson incision, the left ureter was exposed. It was found to be about 3 centimeters in diameter. A stone about the size of one's thumb was removed from a point in the ureter a little above the bifurcation of the iliac vessels. Just above the stone was a walled-off abscess within the ureter, containing about 10 cubic centimeters of thin milky pus. This was accidentally ruptured and the part of the ureter which had contained the abscess and the part containing the stone, a segment in all of about 10 centimeters, was removed. More of the ureter would have been removed except for the dense adhesions between it and the peritoneum which was torn once during the procedure just described. A large cigarette drain was placed at both the upper and lower angles of the wound with a large rubber tube drain leading down to the region of the pus.

The patient was not discharged from the hospital until October 23, 1922, at which time there were two sinuses, one in the old nephrectomy scar and another in the left lower quadrant. At his only recorded visit to our return clinic on November 2, 1922, there was still a small sinus in his loin with a larger sinus in the left iliac region. Both wounds were clean but gave rise to a slight discharge. His general condition, however, was excellent.

I am again indebted to Dr. E. L. Keyes for another case (5) which illustrates what may be accomplished by the non-operative treatment of pyo-ureter due to stricture.

CASE 5. H. B., 21 years old, according to an X-ray film had stones in both kidneys. On May 14, 1921, one large and several small stones were removed from the right kidney. Two weeks later the left loin became painful and tender with an increase in temperature. The left kidney, very adherent and full of thick pus, was removed. No stones either in the kidney or its ureter were found.

The patient left the hospital 3 weeks after the last operation but from that time until comparatively recently, has experienced more or less trouble referable to the urinary tract. At first there were pains, without fever, in both loins. The right sided pain was due to a stone (shown by X-ray film) in the right ureter. This stone was finally passed in October, 1921, and relief experienced. However, catheterizations and dilatations of the right ureter were subsequently necessary before her right side ceased giving symptoms.

The pain in her left loin was shown by cystoscopy to be due to a pyo-ureter. Great gobs of pus were found in the bladder, while urine from the right ureter was clear. Washings of the left ureteral stump (the capacity of which was about 10 cubic centimeters) confirmed this and while relief always followed irrigations of the left ureter, the loin pain, though becoming less severe, returned with regularity. The pain usually lasted 2 to 3 days and occurred every 2 to 3 months. The pus in the bladder had diminished appreciably.

In 1925, as a result of more left-sided colics, the left ureter was again irrigated and its orifice enlarged by electrocauterization. Irrigations of the left ureter were continued at longer and longer intervals, until finally in November, 1928, she presented none of her old symptoms and her urine showed no pus.

While she has had another right sided colic (probably due to a kink) as recently as January, 1930, her left ureter has given her no further trouble. She feels well, has put on 20 pounds in weight and her *urine sparkles*.

Both Roedelius and Bruett have reported treating cases of pyo-ureter by irrigation alone. Case 6 is appended merely to show how chronic prostatitis may simulate pyo-ureter.

CASE 6. A. Z., male, aged 31 years, entered Bellevue Hospital in June, 1919, with stones in both kidneys. The larger stones were in the left kidney pelvis. On the right side one stone was stuck in the upper ureter. The right loin was accordingly opened. "His kidney is quite adherent, the pelvis distended and a triangular oxalate stone fixed in the upper end of the ureter about 3 centimeters from the kidney pelvis." One small stone was found in the kidney pelvis and one in a middle calyx. The convalescence was stormy, but when he left the hospital 8 weeks after the operation, the phenolsulphonephthalein output was 55 per cent in the first hour after intramuscular injection, and he was so well that he refused operation upon his left kidney until October, 1925. A calculous pyonephrosis was removed and his convalescence, except for an epididymitis, was uneventful.

Three weeks after nephrectomy he passed a considerable amount of thick pus in the urine. Three days later the urine was grossly clear and the left ureter was catheterized, the catheter stopping at 22 centimeters. Two cubic centimeters of 1 per cent mercurochrome was injected into the ureter. This catheterization was repeated five times during the next 4 months. On three of these occasions 1:500 silver nitrate solution was injected. The urine from the right kidney pelvis never contained any pus. He was having discharges of creamy pus about once in 6 weeks, regardless of the injections. (No accumulated fluid was ever drained from the ureter when the catheter was introduced.) In May, 1926, 7 months after nephrectomy, the pyuria became rather more continuous and was attacked

for the first time by prostatic massage. This promptly diminished the output of pus. Prostatic massage was continued for 1 year before the pyuria permanently cleared up. The patient was last seen in July, 1929, with only a few pus cells in the urine and no symptoms.

SUMMARY AND CONCLUSIONS

1. Pyo-ureter is caused chiefly by two factors: (a) obstruction, and (b) injury to the nerve supply of the ureter resulting in absence of peristalsis and lack of tone.

2. The chief etiological factor in most cases of pyo-ureter is ureteral stone.

3. While the relative occurrence of pyo-ureter, including even the stone cases, is small, it is a definite menace to life. More attention therefore should be directed toward its prevention. This can be best accomplished by proper treatment of the ureter and its contents at the time of nephrectomy which presupposes a careful study of the ureter prior to nephrectomy.

4. While a few cases may be successfully treated by non-operative measures, such as fulguration and irrigation, ureterectomy, especially complete ureterectomy, is indicated in the great majority of cases.

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VARICOSE ULCERS

Treatment with "The Rubber Sponge or Venous Heart" and Supportive Bandage[1]

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CHRONIC ulcers of the lower leg, like all ulcers of the body, are produced and maintained by malignancy, trauma, infection, circulatory changes, or combinations of these factors.

Ulcers due to malignancy are quite rare and are characterized by an indurated edge, lack of inflammatory changes, progression in spite of treatment, and positive biopsy findings by means of which they may be recognized.

Certain ulcers caused and maintained by specific infections such as syphilis, tuberculosis, and actinomycosis also have characteristics by which they may be recognized and diagnosis may be confirmed by blood tests and microscopic examinations of the tissue or curettings.

Buerger's and Raynaud's diseases, by narrowing of the terminal arteries, produce a decrease in the arterial blood supply to the extremity and very often produce a state of dry gangrene or chronic ulceration as a direct result. However, ulcers due to these two conditions most often affect the toes and feet. In one case with varices size three in the thigh and size two scattered widely over the lower leg with an ulcer dollar size internal to the ankle there was a marked Raynaud's disease present. This involved both the feet and hands. The case has since had a sympathectomy on both lumbar and cervical segments with much relief, a fact which would prove the diagnosis.

Very often elderly patients with arteriosclerotic conditions of the terminal arteries present themselves, due either to the pain and ache in the lower legs, or to the ulcerations and gangrene which develop as the end-result. Oftentimes they will have varices associated and may have trophic ulcers present, yet the arteriosclerotic condition is the predominant and newly developed factor.

Leaving out the already described types of ulcer of the lower leg which have all had a well defined etiology, we are left with that vast majority of ulcers which may or may not have had trauma as an originating cause but the continuance of which must be due either to less specific types of infection or to factors of circulation other than Buerger's or Raynaud's disease. If they are associated with demonstrable varices they are called varicose ulcers.

All varicose ulcers should be subdivided into three groups:

1. Those which respond to treatment and heal rapidly.
2. Those which have in reality become trophic ulcers with such a lowered state of vitality and scar tissue formation that they do not seem to heal yet do not have any marked degree of œdema present.
3. Those that exist due to lymphatic blockage following repeated attacks of thrombophlebitis and cellulitis.

The two latter groups are in reality no longer varicose ulcers but trophic states existing as the end-result of the long continued infection.

Loewenfeld has studied the bacteria in chronic varicose ulcers of the leg. He has found that the infections in these ulcers usually hold a veritable menagerie of bacteria, the most common of which were staphylococcus, streptococcus, pneumococcus, and colon bacillus. He stated that no organism may be held as a specific cause and that the germs present had little to do with the lack of healing (read Lewis Circular).

Nobl stated that he never had the impression that recovery was in any way due to greater or less aggregation of germs. The truth of these opinions is well proved by the multiplicity of antiseptics and chemical tissue stimulants that have been used in the treatment of these ulcers in the past, always with but slight or unsatisfactory results as far as production and maintenance of healing is concerned. Loewenfeld also stated that those ulcers which heal most rapidly often contain the most bacteria.

What then is the reason for the inability of the body to heal this vast majority of leg ulcers?

Delbet and Mocquet, of Paris, stated that varicose veins were produced by progressive breaking down of valves in the external saphenous veins beginning at the main valve at the saphenofemoral junction, allowing a reflux flow and alte-

[1] The author is collecting statistics relative to fatalities associated with the injection treatment of varicose veins. He would consider it a great courtesy to both himself and the profession in general if any and all physicians having information relative to such fatalities would kindly communicate with him with as much detail as regards the case as possible. It is only by means of such co-operation that accurate and complete statistics can be obtained.

It has often been stated that physicians have refused or neglected to report such cases through fear of criticism. Such fears are groundless inasmuch as no names, of either doctor or patient, will be mentioned except at the request of the physician in charge.

nate dilatation of the saphenous branches. This mechanism as the whole cause of the production of varices has been disputed. However, in the more advanced stages of varicose veins there is no question as to the truth of the mechanics of flow as pointed out by their papers. Trendelenburg, in 1890, wrote a classical paper on this condition and his methods and conclusions still stand accepted today. The Trendelenburg test is still the commonly accepted method of determining this point as to the reflux flow. It has been beautifully demonstrated by the injection of lipiodol and direct observation under the fluoroscope as published by one of us in a recent article. The mechanics as described can be best shown by a diagram (Fig. 1). This shows progressive breaking down of valves with ultimate vicious circle of blood flow.

The pressure of blood in the veins of the lower leg in the varicose condition has been measured and found markedly increased. Delbet, von Meisen, and others have reported it at 26 millimeters of mercury. We have checked this repeatedly and have found it to average 88 millimeters of mercury in the extensive cases of varices of the calf. This increase of reverse pressure eventually causes a separation or widening of the spaces between the cells of the terminal capillaries and allows the blood plasma to be forced outward into the tissues, producing œdema. This reflux flow extending out into the tissues not only waterlogs the tissue, stretching fibers and cells apart, but also keeps the tissue cells surrounded by a serum poorly oxygenated, lacking in food, and saturated with lactic acid and other products of combustion which, if not eliminated, tend to produce acidosis. Due to this tissue congestion and saturation with serum and to the secondary infection which develops, there is a marked lymphatic stasis locally as well as at times in the area below the ulceration. This is best explained by a mechanical strangulation or blocking of the lymphatic channels and ducts by the induration of the tissues which develops. The experimental work of Homans, of Boston, makes this most clear and Trout[1] has gone into this phase of the pathology very much in detail in his last article (Fig. 1). Is it any wonder that slight trauma or hæmatogenous infection can easily produce an ulcer in these tissues and that when an ulcer is present that it shows little tendency to spontaneous healing?

[1] Though the authors do not agree with Dr. Trout in his radical work except for a much more restricted type of ulcer yet they believe he has presented one of the best papers on the subject in recent years. He has given a thorough résumé of the literature citing many authorities on all phases of the work. His bibliography is unusually complete and thorough.

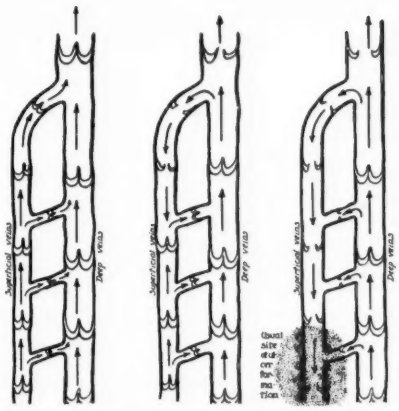

Fig. 1. Graphic illustration of direction of venous flow in the superficial and deep veins both in the normal state and in the case of extensive varicose veins with ulcer formation.

Closely related to the ulcer, often underlying or running about its margin, one may find one or more large varices (Fig. 2). Payne has called these associated varicosities "stagnating, stinking sewers, inundating an adjacent field and rendering it barren."

The actual ulceration begins with a gangrene and separation of the superficial layers of the skin, secondary infection soon takes place and may produce changes giving the ulcer the appearance of a carbuncle with raised, indurated margins and a sloughing base. There is a general cellulitis present in the tissues locally. Ulcers in this stage are very painful. Later the ulcerations may extend through all the dermal layers and even further, so that at times when the ulcer is over the tibia we may have a marked periosteitis complicating and giving a very painful condition. In some cases a weeping eczema of the surrounding skin and even of the whole leg may be present. There is some evidence of attempts at spontaneous healing in many ulcers but this is expressed usually in more recent ulcers by pale hydropic granulations of the ulcer base. In the deep ulcers periosteal thickenings and bony spicules may be present. In some cases of long standing the whole lower one half of the lower leg may be involved in a fibrotic process and be hard and board-like.

It is our opinion that the mechanism of reflux flow, with increased downward venous pressure and the consequent waterlogging of tissues with stagnant serum is the prime cause for these destructive and abortive healing processes though trauma to this lowered area of vitality is usually

Fig. 2. Association of the varicose vein with the ulcers.

the active cause of the terminal breakdown and ulceration. Any logical method of treatment must be aimed at correction of this abnormal flow. Removal of the main saphenous varices, thus stopping the main reflux flow of blood, can be accomplished by three methods:

1. Surgical removal as practiced in the past by one of the many accepted methods.

2. Surgical removal plus injection—practiced by comparatively few men.

3. Injection treatment with sclerosing solutions. This is now accepted as the only justifiable method.

Destruction of reflux venous flow, however, except in some of the more superficial and recent ulcers, is not sufficient to produce healing. One must also in some way remove the inundating stagnant serum and lymph from the tissues and at the same time enhance the opportunity of the tissues to receive a more constant supply of arterial blood with its revitalizing properties.

A number of measures producing compression and support to the tissues have been used both here and abroad for many years. Most of them had been used before the injection treatment had become popular. The most commonly used are as follows: (1) rubber stocking, (2) elastic stocking, (3) Unna's cast, (4) Zedeno's bands, (5) Boynton's adhesive—(a) just over ulcer, (b) toes to knee, (6) gauze pad with elastic bandage, (7) rubber sponge with elastic bandage.

Favorable results are reported in the use of each and all of these methods of treating varicose ulcers and in our own work we have adopted and used the last named method, inasmuch as it is the most effective one to remove œdema, to aid blood supply to the tissues, and thus to promote healing. The Unna's cast is reserved for use when continued support is desired after the ulcers have healed. This is about the only place in which it is used today. In its place we may use any one of the bandages if preferred.

In our use of the rubber sponge we feel that we have gone a step farther than Professor G. Nobl who first introduced its use in the treatment of ulcers. It is true, as explained by Nobl, that mere compression will aid in forcing the blood serum and lymph from the tissues and at the same time compress the coarse hydropic granulations that overgrow and literally smother and choke out the normal epithelial cells which attempt to spread over the ulcerations. Compression, however, is not enough. We have found that one more measure is necessary to get the best results. After the sponge is bound in place very tightly with an Ace bandage, if the patient does not walk he will suffer a great deal of pain and often demand the removal of the sponge and bandage or even remove it himself on account of the severe pain. If, however, the same patient is impressed by his doctor of the advisability and necessity of doing a great deal of walking with the sponge and bandage applied, as above directed, instead of having pain he will find that the pain and soreness in the ulcer area rapidly disappear. Not only will the soreness disappear but active exercise of his legs gives other important results.

In the title of this paper we have called the rubber sponge "the rubber heart." During the walking that we are emphasizing we feel that the sponge acts very much in the way of a heart, not only passively compressing tissues but with each systole of the sponge actually actively pumping serum, lymph, and venous blood from the tissues and small blood vessels and allowing with each

Fig. 3. Typical varicose ulcer. Eight years' duration. Same leg months later, after treatment with rubber sponge, Ace bandage, and usual dressings.

sponge diastole a fresh flow of arterial blood into these vessels and tissues. Thus the sponge gives a soft, gentle massage to the tissues when the patient is walking. We explain the pumping action as follows: Each time a patient takes a step his calf muscles, while contracting, bunch up momentarily, giving a tug on the Ace bandage which is passed on to the rubber sponge. This produces a live compressive action of the sponge which alternates with a comparative relaxation period when the calf muscles relax. Firm pressure is maintained all the time, however, though intermittently increased. The truth of this mechanism can be easily proved if one feels of the rubber sponge while the patient is walking.

It is more clearly and graphically shown when the rubber cuff of a blood pressure manometer is placed over the ulcer or calf and bandaged with the 4 inch Ace bandage. The bag should be inflated to the size of a rubber sponge actually used in treatment. When the bandage is wrapped firmly, as in a case with much œdema and infection, the manometer will show a pressure of about 80 millimeters of mercury. When the patient stands and shifts the weight of the body back and forth, first on one foot and then on the other, the reading of the manometer will vary 80 to 100 millimeters with each firm contraction of the calf muscles. This increase of pressure each time, is passed on to the tissues beneath, thus giving the massage or pumping effect. This being the case the rubber sponge can rightfully be called a "rubber or venous heart." The tightly wrapped, semi-elastic Ace bandage gives steady compression on the leg generally and overcomes the reflux flow and lymph stagnation. The superfluous fluid is thus forced from the tissues and pumped up and out of the leg.

The theory of the treatment rests on the belief that the patient's heart will pump fresh arterial blood filled with oxygen and tissue food to the extremity and ulceration, but that we must aid the circulation to carry off the products of combustion and ketosis which cause the local acidosis and tissue death. This is most admirably and efficiently done by a supportive Ace bandage and good grade rubber sponge combined with walking. In other words the patient's heart will pump the arterial blood to the extremity and our rubber or venous heart will pump it back and thus return the vitality of the tissues to their normal state by the rapid and normal interchange of blood constituents.

This method of treatment is so radically different from that practiced in the past that it is hard to convince the patient of its rationale. Oftentimes the patient has had several recurrences and each time the doctor has promptly impressed him with the seriousness of the situation and the importance of "bed rest." The patient has usually readily accepted the dictum as his only recourse and has often lain in bed for days, weeks, or months with the legs in elevation to relieve the back pressure of the venous circulation and to allow the effect of gravity to drain off the serum and lymph causing the œdema. With the patient in this helpless situation all sorts of ointments and lotions have been applied and of late years the ultraviolet light has been used a great deal. The latter, the authors believe, has been used more for the psychological effect than for any truly inherent healing value. Each time the legs may or may not have healed but have left the tissues scarred and more subject to another recurrence of the ulcer and more in need of supportive care and treatment than before. Is it any wonder that these patients hesitate to believe the sanity of instructions and treatment when it is so diametrically opposed to that which they have paid good money for in the past? It is thus clear that the patient must be thoroughly "sold" on these modern methods though at times it is certainly a hard and difficult process.

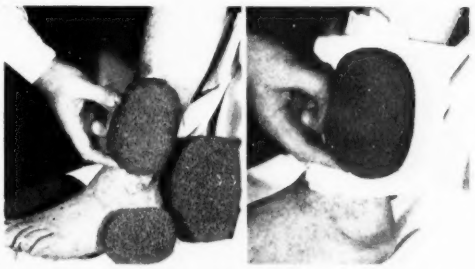

Fig. 4, left. Shows rubber sponges of assorted sizes. The appropriate size selected for this particular case.

Fig. 5. Ulcer has been dressed with ointment, and fluffed gauze and sheet wadding has been applied. The appropriate size sponge in place.

The actual care and treatment of a varicose ulcer with the rubber sponge and Ace bandage is as follows:

1. Cleanse the skin and ulcer area with gauze wet with benzine.
2. Apply 10 per cent silver nitrate to the ulcer. This stimulates but is of no value at the first dressing of a badly infected and necrotic ulcer.
3. Apply some mild ointment to the ulcer area that will remain *soft*. Many ointments dry and cake.
4. Apply several layers of fluffed gauze.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 6. Sponge and dressings bandaged in place with 4 inch plain gauze bandage.

Fig. 7. Ace bandage (4 inch) being applied from above downward.

Fig. 8. Lower leg completely bandaged with Ace bandage (4 inch) from knee to toes, double figure of eight wrapping about ankle and foot. This holds the rubber sponge or "venous heart" in position over the ulcer which gives the "pumping effect" on walking.

5. Cover this with 4 layers of sheet wadding or cellucotton.

6. Select a *good grade* rubber bath sponge (firmest possible), that is one inch larger than the ulcerating area.

7. Bandage this all in place with a 3 inch plain gauze bandage. Be very careful that the dressing and sponge does not slip to one side.

8. Apply a 4 inch Ace bandage from just below the knee to the toes over the sponge and dressing. Bandage firmly. The more cellulitis and the worse the ulceration the tighter the bandage must be applied. Apply it as a double figure of eight about the foot and ankle.

9. Sell the patient *completely* as to the point that *the more he walks* with the leg thus bandaged, the *quicker* will the ulcer heal.

10. *Never* apply the sponge and bandage described to a bed patient.

11. Change the dressings often enough to keep them from becoming saturated. Every 2 days is preferred. The rubber sponge can be boiled up and used again when soiled, but should be discarded as soon as it has lost its "kick" and has become firmly pressed together.

Observation of an ulcer after a few days use of the sponge and Ace bandage associated with walking will often amaze one with the rapidity with which the old, sloughing or hydropic tissues can be converted into clean, fresh granulations which bleed easily with a bright, fresh arterial type of blood. The secretion from the ulcer surface diminishes rapidly, the cyanosis of the ulcer disappears, the œdema of the surrounding tissues melts away, the tissues become soft and tend to approach the normal. Thus, ideal conditions are maintained for the ulcer healing, the end-results are reached in a comparatively short period, and the patient continues on at work during the entire time. Such cannot be said of any other method of treating varicose ulcers today.

Any type of pressure over and about the ulcer will *tend* to approach the method described but so far has proved less efficient. Some men strap wide bands of adhesive about the leg and over the ulcer. This will give local pressure but the case will improve much more rapidly if the rest of the lower leg is supported at the same time. This is more true if there is much cellulitis and œdema

The new Klebro bandage and the Tricoplast bandage both serve admirably for support after the case has healed. They are also fine in cases of eczemas, healed but in need of further support. The former in particular is effective since it will adhere to the skin, does not make the skin sore, can be worn for 4 to 6 weeks at a time, is pliable, and will stretch sufficiently that it can be applied to a funnel shaped thigh or leg. Baths can also be taken with it in place as it is made with a wax base and will not loosen with water.

For those cases needing continuous support, yet who prefer to remove it each night, the Ace elastic or the new B. and D. silk elastic bandage, or the elastic stockings serve very well.

The authors agree with Drs. Homans and Trout that there are ulcers, truly varicose to begin with, but which no longer have any varicose veins present or associated with them. These would correspond to those in groups 2 and 3 in our classification. In most cases these are in reality trophic ulcers and are complicated by the immense amount of scar tissue and lymphatic blockage that has formed by their many recurrences over a period of years. Group 2 is the indolent type persistent at times over the tibia or about the ankle with but little œdema present. This is best treated by excision and skin grafting or by preparing as previously advised (5) and grafted without excision. External support must be continued for a long time after the grafts have healed. Those ulcers in group 3 may be treated by the excision of the ulcer combined with skin grafts and a modified Kondolen operation. This *may* offer an outlook for a cure and for relief from some type of supportive bandage. In our hands, however, the patients with these extensive and recurrent ulcerations have been so comfortable and have had so little disability that they much prefer to go on with the continuous supportive care and treatment than to accept the long hospitalization and operation with all the pain and distress it entails. Except in the unusual and rare case we most emphatically disagree with them and are convinced of the superiority of this plan of treatment.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JUNE, 1931

PEPTIC ULCER

ONE of the hopeful signs of the times is the changed attitude toward each other of the internist and surgeon with regard to the treatment of peptic ulcer. One has but to note the trend in current medical literature on this subject to be struck by the fact that no longer are the leaders in the two main branches of medicine engaged in acrimonious controversy when the subject of peptic ulcer is under discussion. But, on the contrary, one will observe with great satisfaction that the surgeon is now quite willing, indeed anxious, to avail himself of the aid rendered by the internist in matters of diagnosis and treatment, both pre-operative and postoperative. The best physicians, in turn, no longer claim to cure peptic ulcer without fail and unaided, but appear quite willing to give their patients the benefit of what well considered and well performed surgery may offer. Thus the avoidance of extravagant and unwarranted claims on the part of overenthusiastic representatives of both branches of medicine, together with the development of closer co-operation between them, will go a long way toward removing the confusion that has resulted in the past in the minds of the average surgeon and the general practitioner, as to the best methods of treatment of this important affection.

Among the factors responsible for this improved condition may be mentioned a more careful and judicial study of the end-results in a large number of cases, over a sufficiently long period of time, in order to eliminate certain errors inherent in a study limited to insufficient data; and, on the other hand, to arrive at trustworthy conclusions bearing the weight of authority based upon accumulated experience and careful analysis.

A glance at the end-results of treatment by either medicine or surgery will show conclusively that it ill becomes either side to boast unduly of its own results, or to criticize harshly those of the other. The percentage of failures reported, even under the most favorable conditions, and by all methods of treatment, are to date far too high to justify over-confidence or any relaxation of effort upon the part of the medical profession as a whole, to find a satisfactory solution of the perplexing problems involved, and as yet unsolved. One of the chief causes of delay in finding such a solution heretofore, has been a marked tendency among writers to assume the rôle of advocate rather than that of judge; to make a special plea for some particular form of treatment, rather than an impartial statement of facts, and let them speak for themselves.

A certain diversity of opinion in the matter of treatment is not to be wondered at, indeed is inevitable, in the consideration of so complex an affection as peptic ulcer, especially so

when one stops to consider that even at this late date its etiology remains unknown and, therefore, methods of treatment, whether medical or surgical, must, of necessity, be largely empirical. This unsatisfactory condition will, in all probability, continue until our knowledge as to the causation of peptic ulcer is more exact. Real progress, therefore, for the present at least, would appear to lie in this direction.

As a matter of interest, if one compares the results as given in the symposium on peptic ulcer at the last meeting of the American Surgical Association[1] with those of equally responsible medical authorities,[2] one will at once be struck by the fact that for the first year, at least, the difference between them is comparatively slight, but, as time goes on, the percentage of recurrences after medical treatment becomes increasingly more pronounced. This would seem to indicate that medical "cures" are less permanent than surgical.

In this connection, when speaking of "cures," several facts are not infrequently lost sight of, namely, that peptic ulcer is probably of more frequent occurrence than is generally supposed and that, except for the complications—perforation, hæmorrhage, malignant degeneration, etc.—that may result therefrom, it does not tend to a fatal termination, but rather to spontaneous cure. The frequency with which evidence of existing or pre-existing ulcer is observed at autopsy, or upon opening the abdomen for other affections, would seem to bear out this statement. In giving credit, then, to any particular method of treatment for an apparent "cure," the *vis medicatrix naturae* cannot be ignored, since it is a matter of common knowledge that ulcer has a strong tendency to heal, or, at any rate, toward remission of active symptoms. This, in turn, is offset by an equally strong tendency toward recurrence, seasonal or otherwise. All these factors tend to create confusion when one comes to speak of cure.

Therefore, in the discussion of this subject, either with one's patients or fellows, it is well to observe a certain amount of restraint in the matter of sweeping statements unsupported by facts, and the making of extravagant claims that cannot be substantiated by indisputable clinical or pathological evidence. Care should be taken to avoid falling into the error, either of undue optimism, as do some, or of unwarranted pessimism, as do others.

The combined experience of many surgeons and physicians shows conclusively that a large percentage of patients are permanently cured, either by medical treatment alone, or following a surgical operation, and that a smaller percentage are little, if any, benefited by either course, and that the mortality rate after surgical operation, as well as that due to perforation, hæmorrhage, etc., after strictly medical treatment, while definite, are not high. The physician or surgeon, therefore, when consulted by a patient with peptic ulcer, is to be justified neither in withholding from his patient the possible benefit from surgery, nor, on the other hand, the rushing him too precipitably into it. Here, as elsewhere, is needed the exercise of that *sine qua non* in good surgery—surgical judgment—with regard to the question as to when to operate, if at all, and what should be the nature of the operation. Among the conclusions that emerge from unbiased discussion of this subject, none stand out more clearly than that surgery should begin where medicine leaves off. In other words, every case of peptic ulcer should be given the benefit of the best medical skill available before being subjected to operation.

As to the types of operation to be employed, again it remains for surgical judgment and experience finally to decide. However, caution

[1] Ann. Surg., 1930, October.
[2] Crohn, Affections of the Stomach, Philadelphia: W. B. Saunders Co., 1927.

may well be exercised especially by the inexperienced surgeon, lest he be carried away by the rosy reports of the advocates of the radical resection method. It is a difficult matter to convince conservative surgeons that the indiscriminate use of an operation which sacrifices so great a portion of so vital an organ as the stomach, for so small a lesion as peptic ulcer, which, moreover, is so comparatively innocuous, and which tends so strongly to spontaneous cure, is justifiable. Is it quite logical to claim, because the mortality rate is comparatively low and the immediate results apparently good, that routine subtotal resection of the stomach is the best operation? May it not rather go to show just how tolerant to punishment the human organism really is? Which is the more logical, to claim that because the Scotch are admittedly a hardy race, and because oatmeal is one of their principal articles of diet, that, therefore, oatmeal is an excellent food; or that the fact that they do thrive on oatmeal simply goes to show just how hardy a race they really are, to be able to flourish upon such a diet?

The improved condition with regard to the general status of peptic ulcer, to which earlier reference has been made, augers well for a still further advance in the future, if a more judicial approach is had to the study of the problems involved, especially those factors underlying the etiology of the affection, in order that thereby a more rational method of treatment may be developed than the empirical methods now in use. J. M. T. FINNEY.

THE RÔLE OF SURGERY IN REDUCING THE COST OF MEDICAL CARE

NOT infrequently arises the cry that too much surgery is being done. Those who raise such a cry probably are excited by finding a patient who may have been unnecessarily subjected to an operation. Such cases are few, however. It is commoner to see patients who should be operated upon and are not, or patients who are operated upon but only after the hour of grace has passed.

It is said that the death rate from appendicitis is increasing. If this is true one of the causes may be the advent of a generation of doctors who have become overcautious, too timid souls who have been scolded so much about taking out normal appendices that they allow many diseased appendices to remain too long. The same observation applies to the gall bladder, stomach, and other organs.

It can no longer be said that there are surgeons who deliberately operate upon organs which they know to be normal. The day of such men has passed, if there ever was such a day. Certainly the average surgeon who tells his patient that he has cholecystitis or peptic ulcer is honest in his belief, and generally diagnoses the condition correctly. In such cases long experience has shown that cure can be brought about only by surgical means, and patients should be given the advantage of prompt operation.

In untreated surgical conditions or in patients operated upon late, the accumulation of complications not only is responsible for a higher morbidity and mortality rate, but also for great economic loss and a material part of the increase in the cost of medical care. As an example, consider the badly managed case of acute appendicitis in which somebody endeavors to "get the patient by the attack." What happens? The appendix becomes gangrenous or ruptures; peritonitis supervenes, and finally the patient is brought to the hospital as a last resort.

Many such a patient dies in a few days; but if he lives, at what price? By great loss of time and much suffering and expense on

the part of many people, not to speak of the mental and physical strain on the physician and surgeon. Well-timed surgical treatment would have diminished by 75 per cent or more the financial burden and every unhappy accompaniment. And often the story is not finished, when, after many weeks' or months' disability the patient returns to work. A year or more later he may again be brought to the hospital with acute intestinal obstruction, which may cost his life or another long illness with its heartaches and great expense.

The consideration of these every day happenings should not be overlooked by those who are concerned with the study of the cost of the prevention and cure of disease. One remedy may lie in giving increased attention to the teaching of practical medicine both to undergraduate and graduate students. In our efforts to investigate the new and rare in medicine, are we not apt to neglect the common old things by which we are surrounded constantly, and from which there is no escape?

Untrammeled by ignorance, inexperience, and prejudice, prophylactic surgery is prepared to contribute a significant quota to the reduction of the cost of medical care in all its phases. FRANK K. BOLAND.

MASTER SURGEONS OF AMERICA

MANUEL TOUSSAINT

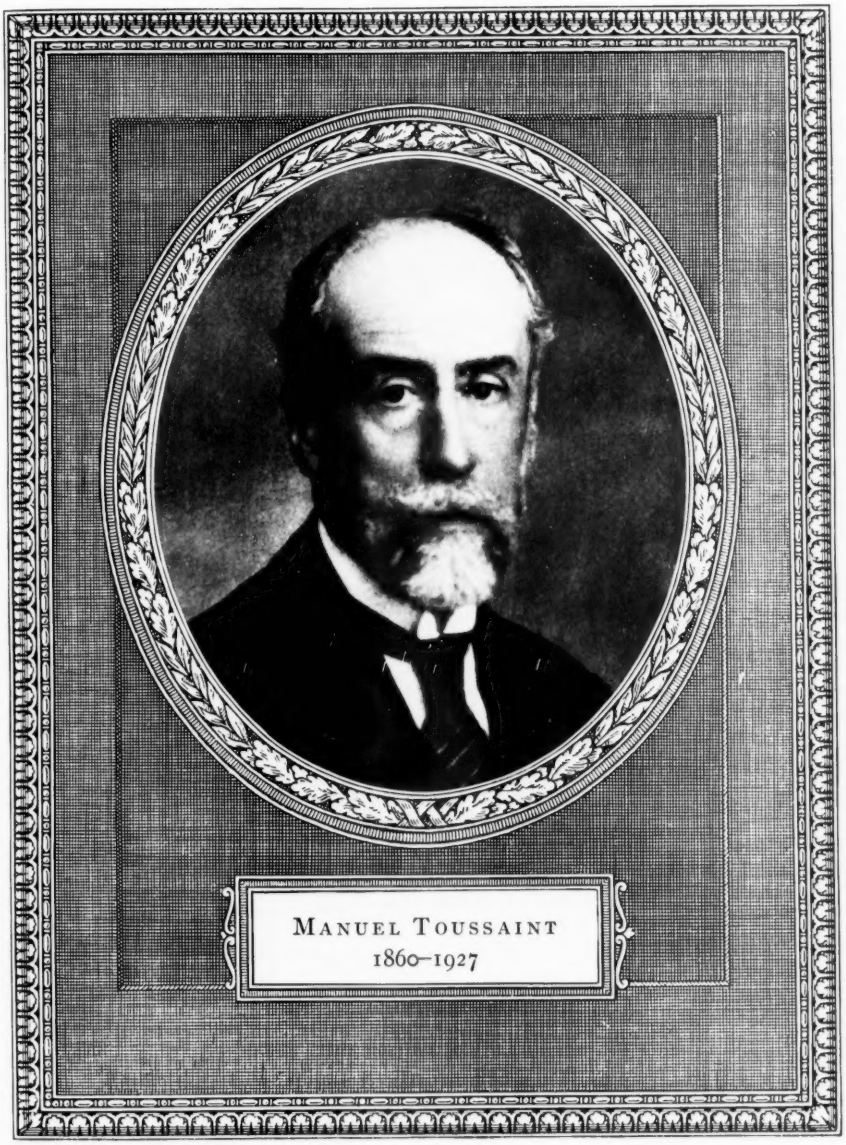
ONE of the most outstanding figures in the contemporary medical world was Dr. Manuel Toussaint. He was a physician endowed with vast knowledge, a wise and experienced clinician, a skilful and careful surgeon, and a gentleman above reproach. In him were thus combined so many excellent qualities that it has been difficult to find anyone to replace him.

Dr. Toussaint was born in the city of Puebla in 1860. He began the study of medicine in Puebla but later, in 1884, after an examination at the capital he was given the title of physician and surgeon. He began his professional career by serving in the Military Medical Corps and was commissioned to go to Europe to study hygiene. Eager to learn, he went to Germany and after having fulfilled the object of his commission he took up the study of other branches of medicine, such as bacteriology, histology, and pathological anatomy, which, in those days, were not very far advanced in our country. Under professors of note, such as Virchow and Weigert, Koch, Fraenkel and Petri, he studied these important subjects for three years. He completed his studies abroad by taking courses in surgery under the direction of Bergmann and Kuster and in medicine under Linden and Senator. He then went to France where he pursued his favorite studies further.

He returned to Mexico eager to apply his knowledge. First, he became affiliated with the National Medical Institute, in which he rendered important service in the school of medicine. Here after a competitive examination he taught histology, and had charge of the department of pathological anatomy which was created especially for him. Finally in the Institute of Pathological Anatomy he did work of great interest which is referred to later.

His work as a surgeon began in the hospital of Jesus of Nazareth, founded by Cortes, and was continued in the Hospital de la Beneficencia Francesa, of which he was director. He was especially interested in surgery of the stomach and bile tract, in which work he acquired great skill.

An old calculous cholecystitis which had seriously affected his liver and for which he was operated upon a little while before his death by one of his pupils, was the cause of the death of this master—a master in the highest sense of the word—in September 4, 1927. He who knew the anatomy of the liver to the



MANUEL TOUSSAINT
1860–1927

most minute detail, he who was master of hepatic pathology and who had removed many lesions of the liver died of the disease of which he had so many times cured others, as if haughty death took this way to avenge himself on his conqueror.

The scientific work of Dr. Toussaint was concerned particularly with pathological anatomy. His study of cirrhosis is worthy of mention; he set forth ideas now accepted by such clinicians as Sergeant but which he propounded many years before. He studied the etiology of typhoid and, indeed, ate infected substances to see if they would produce the infection, but fortunately they did not. He has published in different medical journals articles on his studies of actinomycosis, rhinoscleroma, intestinal pneumatosis, the cytology of the blood in syphilitis and, as well, on many other subjects.

He filled many honorary posts and commissions and left in them all indelible traces of his brilliance. He was a colonel in the Medical Corps, director of the Institute of Pathological Anatomy of the General Hospital and the Hospital de la Beneficencia Francesa, professor of the school of medicine, doctor of the National University, and member of the University Council, of the Mexican Medical Association and, as well, of various foreign scientific societies.

He was a representative of his country at different international congresses, once in Russia and another time in Buenos Aires. This enabled him again to visit the principal European medical clinics as well as those of the South American republics.

This is but a rough sketch of the career of Dr. Toussaint. To all who knew and associated with him he was known as a man who did honor to his country as he would have done honor to any country in which he might have been born, and so it is fitting that, as a just homage to the wise physician and the noble and generous man, his name be included with those who have done much to advance surgery in the Americas.

BENJAMÍN BANDERA

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA

LANFRANCUS OF MILAN

As the authority of the school of Salerno waned the position of the sites of supremacy in medicine and surgery tended to spread northward, in Italy, to Bologna and passing still farther north to Montpellier and Paris in France. One of the important elements in helping this northward spread was the banishment of Lanfrancus of Milan. Lanfrancus was born in Milan and spent his early professional years as a practicing physician and surgeon in his birth place. At this time, the last half of the thirteenth century, the most notorious thing in Italy was the constant war between the Guelphs and the Ghibellines. It set family against family and town against town and as is usual in small factional fights the feeling engendered was extremely bitter. The original bone of contention, the pre-eminence of the Pope on the one hand or the Emperor on the other, had been more or less forgotten and by the third quarter of the thirteenth century the fights had become local and family ones.

Lanfrancus had ranged himself on the side of the Guelphs and in 1290 they were beaten. The leader of the Ghibelline faction, Matteo Visconti, at once banished Lanfrancus from Italy. He fled across the border to France and at first settled in Lyon. Here he busied himself in writing his *Chirurgia Parva* (Little Surgery). After he had been in Lyon a short time he travelled throughout France, always practicing, and finally in 1295, five years after his banishment reached Paris. His reputation must have preceded him for immediately upon his arrival in Paris he began to teach and students flocked to him in great numbers to attend his clinics and watch his operations. He became known immediately and was soon asked by his students, by the masters in surgery, and even by Jean de Passavant, the dean of the Paris faculty, to write a larger surgery. It would seem that this book must have been in his mind for some time and probably some of it had been written soon after the Little Surgery was finished for he states that he finished the great surgery in 1296, only the year following his arrival in Paris. His dedication of his work to Philip the Fair, King of France, was rather interesting. Being in France it was of course the thing for him to do, but at the same time it allowed him to show that he was still a supporter of the Guelphs, particularly at a time of bitter feeling, because the year 1296 marked the great quarrel between Philip and Pope Boniface VIII brought about by Philip's taxing ecclesiastical property to meet the increased expenses of the centralization of his government.

In spite of the great admiration which Passavant felt for Lanfrancus' ability he did not dare run counter to the University requirements and afford him facilities for teaching. The rules required that all teachers of medicine in the University must be clerics and celibates. Lanfrancus, unfortunately for the University, was married and had a son and had to look elsewhere, if he was to teach. The opportunity was afforded by the College de Saint Cosme which had been founded by the Royal Physician Jean Pitard during the reign of Louis IX (St. Louis). This guild of surgeons had attained a position of great importance and its requirements for admission were very strict. A candidate must have studied medicine and philosophy for two years ust understand Latin, and must have studied surgery for two additional years. He was then admitted into the guild and was allowed to wear a long robe in contradistinction to the lower class of less educated surgeons who could wear a short robe only. Pitard apparently waived these requirements for Lanfrancus and the same year that he arrived in Paris, 1295, he became a member of the College and began to carry on his teaching under its auspices.

Lanfrancus' method was entirely different than anything which had been done before. His operations were done in public and to them his students were admitted. His lectures, instead of being the conventional dry reading from a book of one of the ancients, were clinical demonstrations of the patients themselves. Almost immediately his courses became overcrowded and he was the most popular teacher of surgery in France. In this way the surgery of Italy was carried northward into France.

Though Lanfrancus was a pupil and follower of William of Salicet he was by no means as daring in his operative work as either Salicet or his master and predecessor Roger. In fact, Lanfrancus seemed to be imbued with the teaching of the Arabists and reverted to the use of the cautery instead of the knife which latter had been advocated by his master William of Salicet. He was a timid operator and preferred to let nature take its course in serious cases rather than intervene. His greatest reputation rests upon the fact that he was the first clinical demonstrator in France.

Klein Wundartzney.

Von aller-
hand Wundē/
Brüchen/ Schā-
den vnd Gebrechen/ inn vnnd auſſerhalb
Leibs/ wie die gründlichen zu Curieren
vnd heylen ſeyen. Anfenglich durch den Hocher-
farnen vnnd weitberümpten D. Lanfran-
cum inn Latein beſchrieben/ Nachmals
aber gemeynem nutzen zu gu-
tem inns Teutſch ge-
bracht.

Zuſampt einem Außzug viler be-
werter Recepten/ heylſamer Salben/ vnd
Artzneyen/ D. Ottonis Brunfelſij. Jetz-
new inn Truck geben.

Zu Franckfort am Meyn/ Bey
Chriſtian Egenolffs Erben.
M. D. LXIX.

REVIEWS OF NEW BOOKS

THE title *Prosthetic Dentistry, An Encyclopedia of Full and Partial Denture Prosthesis*[1] aptly describes the work. It is a well prepared volume of forty-two chapters dealing with all phases of prosthetics and allied subjects, from a thorough description of anatomical structures to a treatise on the surgical preparation of the mouth for dentures and complete description of technical procedures and mechanical appliances. There are 830 illustrations, all of which are exceptionally well prepared and add much to the value of the work. The text is not confined to the author's opinions but presents much of the best which is recent and accepted in this field. The collaborating authors include many outstanding dental authorities and several technicians, but there is a pleasing lack of useless repetition.

The book can scarcely be considered suitable as a standard text for teaching but rather as a reference collection of the latest thought in this field, more accessible than current literature. A considerable amount of material will prove to be of passing rather than permanent value, especially the minute description of technical methods, which are subject to change, and the pet theories and ideas of individual authors.

A chapter of unusual interest is presented by V. H. Kazanjian on "Prosthetic Restoration of Deformities of Face and Jaw," which is fully descriptive of many ingenious prosthetic appliances for correcting serious deformities.

The book may be considered a useful addition to a dentist's library and can well be read with profit.

CHARLES W. FREEMAN.

THE important system of microscopic anatomy, produced under the general editorship of Wilhelm von Moellendorff,[2] is doing for histology, but in even more ambitious fashion, what that epochal co-operative reference work edited by Keibel and Mall did for embryology some 20 years ago. The plan is much the same. Chapters have been assigned to well qualified experts, and although it is probable that an international representation would have worked to advantage, yet the authoritative contributions as furnished can not fail to command respect. In the present volume the high standard of the parts already published has been maintained. W. von Moellendorff contributes a section on the urinary system and R. Schroeder one on the female reproductive system. Both are masterful presentations of these intricate subjects. The descriptions are well balanced and sufficiently exhaustive. Histologists and all others who may have occasional need to consult original sources will find prepared for them the easiest approach available to the special and detailed information wanted. The illustrations are excellent and adequate, even if less elaborate than those of certain previous volumes. The literature is copiously cited and extensive bibliographies are furnished. Unfortunately, as is customary with European authors, many fundamental American contributions are either not well known or else ignored to the benefit of European equivalents. The price of these volumes, although almost prohibitive to the individual, is presumably necessary in view of the limited distribution open to a detailed reference work of this kind.

L. B. A.

BELL has five collaborators in this volume[3] on pathology, which is somewhat smaller than most texts on this subject. Its format is didactically logical, with individual, often numbered, headings followed by short descriptions. The table of contents is quite complete. The illustrations are numerous and fairly well chosen. In general the drawings of tissue preparations are better than the photographs.

The subject matter is not specifically divided into general and special pathology but the chapters are arranged in that fashion, thus following the traditional manner of teaching pathology. Because of the numerous headings, the general style is somewhat jerky.

Presentation of renal pathology may well attract interest because it is based upon a rich personal experience and well formulated thought. Newer concepts of kidney lesions as presented show a laudable attempt to correlate pathological states with their prototypes. The section on the circulatory system likewise benefits from the knowledge of the special worker.

Proper names and references are used very sparingly in the text, and while this avoids controversial points, it may give the student an ambiguous idea of accrediting special work. An example at random might be pointed in the omission of Cushing's name in the discussion of brain tumors.

This book, on the whole, might be the outgrowth of a system of lectures, and if so, will probably fill its niche.

HAMILTON R. FISHBACK.

[1] PROSTHETIC DENTISTRY; AN ENCYCLOPEDIA OF FULL AND PARTIAL DENTURE PROSTHESIS. By Ira Goodsell Nichols, D.D.S. With collaboration of forty-five authors. St. Louis: The C. V. Mosby Company, 1930.

[2] HANDBUCH DER MIKROSCKOPISCHEN ANATOMIE DES MENSCHEN Edited by Wilhelm v. Moellendorff. Vol. vii.—Harn- und Geschlechtsapparat. Part 1. Exkretionsapparat und weibliche Genitalorgane. By W. v. Moellendorff and R. Schroeder. Berlin: Julius Springer, 1930.

[3] A TEXT-BOOK OF PATHOLOGY. Edited by E. T. Bell, M.D. Philadelphia: Lea and Febiger, 1930.

AMERICAN COLLEGE OF SURGEONS

ORGANIZATION OF SERVICE FOR THE DIAGNOSIS AND TREATMENT OF CANCER—A MINIMUM STANDARD

RECOMMENDED BY THE COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES[1], AMERICAN COLLEGE OF SURGEONS

WHILE recognizing that there are many unsolved problems with regard to cancer, the Board of Regents of the American College of Surgeons, on the advice of its Committee on the Treatment of Malignant Diseases, has announced[2] its policy of emphasizing the necessity of making the benefits of contemporaneous knowledge of cancer available to each and every cancer patient in the country. The College is convinced that, while awaiting future discovery of more efficient methods of treatment of the disease, it is possible effectively to reduce the suffering and mortality from cancer by an organized application of the knowledge that already is available.

The merits of cancer institutes and cancer laboratories are fully acknowledged, but it is felt that there is an urgent need for making our present knowledge more generally effective, and that this need can be met most efficiently through the formation of cancer clinics in approved general hospitals. Such already existing hospitals form the natural centers in which modern diagnostic and therapeutic procedures should be conducted, and constitute a means for an immediate widespread influence on the disease. Ordinarily these hospitals have the personnel and equipment for such service but a definite organization for this special service is necessary in order to obtain the maximum of efficiency in the campaign against cancer. The utilization of already existing hospitals for this purpose has the additional advantage of entailing the minimum of increased expenditure for the accomplishment of the purpose.

[1]The Committee on the Treatment of Malignant Diseases consists of Robert B. Greenough, Boston, chairman; Albert C. Broders, Rochester; Curtis F. Burnam, Baltimore; George W. Crile, Cleveland; Bowman C. Crowell, Chicago; William Duane, Boston; Edwin C. Ernst, St. Louis; John M. T. Finney, Baltimore; Burton J. Lee, New York; Frank Lynch, San Francisco; Robert T. Miller, Jr., Baltimore; Henry K. Pancoast, Philadelphia; H. Gideon Wells, Chicago; and Francis C. Wood, New York. Communications concerning the subject dealt with in this article may be addressed to Bowman C. Crowell, M.D., director of Clinical Research, American College of Surgeons, 40 East Erie Street, Chicago, Illinois.

[2]Surg., Gynec. & Obst., 1930, li, 570.

While the standard herewith presented applies especially to hospitals, other institutions that are shown to have the required personnel, organization and equipment for carrying on the work according to these standards may be included in the list of cancer clinics approved by the College.

In the publication to which reference has already been made the general recommendations of the College in regard to such clinics were outlined. There is presented below a more specific statement in the form of a minimum standard for cancer clinics and cancer services in general hospitals in which are formulated the requirements for an acceptable cancer clinic or cancer service. The Committee on the Treatment of Malignant Diseases takes the position that compliance with this standard forms one of the best methods of assuring to the patient the maximum benefits of our present knowledge of cancer. Explanatory comments on each of the clauses of this minimum standard are appended. These comments are followed by a repetition from the previous publication of the relation which the American College of Surgeons will bear to the cancer clinics.

MINIMUM STANDARD FOR CANCER CLINICS

1. *Organization.* There shall be a definite organization of the service, and it shall include an executive officer and representatives of all the departments of the hospital which are concerned in the diagnosis and treatment of cancer. The services of a secretary and of a social service worker shall be available.
2. *Conferences.* As an essential feature of the service there shall be regular conferences or consultations at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic who are concerned with the case.
3. *Patients.* Reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either volun-

tary or obligatory in accordance with the vote of the medical staff or of the governing board of the hospital.

4. *Equipment.* In addition to the diagnostic and therapeutic surgical equipment which is required in every approved general hospital there shall be available an apparatus for X-ray therapy of an effectiveness which is generally agreed upon as adequate, and an amount of radium sufficient to insure effective treatment.
5. *Records.* In addition to the records which are required in every approved general hospital, there shall be additional records of: (a) The details of the history and of the examination for cancer in different regions of the body, such as are indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons. (b) The details of the treatment by radium or X-ray as indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons. (c) Periodic examinations at intervals for a period of at least five years following treatment.
6. *Treatment.* The treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise.

DETAILED EXPLANATION OF THE MINIMUM REQUIREMENTS FOR CANCER CLINICS

CLAUSE I

Organization. There shall be a definite organization of the service, and it shall include an executive officer and representatives of all the departments of the hospital which are concerned in the diagnosis and treatment of cancer. The services of a secretary and of a social service worker shall be available.

The staff of a cancer clinic or cancer service should include primarily representatives selected from the departments of surgery, pathology, and radio-therapeutics who are qualified by a special knowledge of cancer in their respective fields.

The American College of Surgeons regards cancer as essentially a surgical disease, and as a rule a surgeon who is a Fellow of the American College of Surgeons should be selected as executive officer of the clinic. However, the accurate diagnosis and the effective treatment of cancer today must be regarded as a group problem which requires the co-operative efforts of representatives of these several departments who have been trained adequately to bring contemporaneous knowledge and experience to the consideration of the individual cancer case.

Within the surgical division of the clinic representatives of the surgical specialties, such as gynecology, urology, and surgery of the diseases of the eye, ear, nose, and throat, should be included, and representatives of the departments of internal medicine and dermatology and such other special departments of the hospital as may be concerned in the diagnosis and treatment of cancer cases should also be included.

The special services of a secretary are essential for recording accurate data in regard to the diagnosis and treatment, and for the maintenance of card catalogues with cross references of patients and diseases. The social service worker's assistance is of the utmost value in maintaining an effective follow-up system by which end-results of treatment may be determined, and she should work in close co-operation with the secretary of the clinic.

CLAUSE II

Conferences. As an essential feature of the service there shall be regular conferences or consultations at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic who are concerned with the case.

The essential feature of a cancer clinic is the group method of study of cancer cases. This is accomplished by a conference of the staff which includes representatives of all of the departments concerned. Such a meeting may be held daily or at longer intervals. It may be formal or informal, but its purpose should be the discussion of the diagnosis of each individual case, the consideration of the details of information obtained from the pathological and radiological laboratories, and a discussion of the methods of treatment which may be expected to give the best results. In addition to the discussion of individual cases by members of the clinic staff, from time to time reports should be presented of the end-results of treatment of different forms of cancer, with a comparison of the results obtained in similar cases in other clinics.

In the development of these conferences of the members of the clinic, it is of great value to encourage the attendance of members of the medical profession who are not members of the clinic, and to present at intervals patients who have been the subject of previous treatment.

CLAUSE III

Patients. Reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either voluntary or obligatory in accordance with the vote of the medical staff or of the governing board of the hospital.

As a matter of expediency, at the time of the first organization of a cancer clinic reference of patients to it may be made a purely voluntary matter on the part of the other members of the hospital staff. As the clinic becomes established in many hospitals it is found desirable that all cases of cancer or suspected cancer should be automatically referred to the cancer clinic for preliminary investigation. In any case, it should be obligatory that all cases of cancer on discharge from the hospital be referred to the cancer clinic for subsequent follow-up.

CLAUSE IV

Equipment. In addition to the diagnostic and therapeutic surgical equipment which is required in every approved general hospital there shall be available an apparatus for X-ray therapy of an effectiveness which is generally agreed upon as adequate, and an amount of radium sufficient to insure effective treatment.

Every approved general hospital at the present day has instruments and apparatus available for diagnosis where operative procedures, such as the examination of the bladder, bronchus, œsophagus, rectum, and sigmoid, are required, together with the instruments and appliances for general surgical work, including electro-surgical equipment. An approved hospital has also a complete X-ray apparatus for diagnostic purposes. However, for the effective treatment of cancer cases the department of radiotherapy should be supplied with equipment sufficient to insure high voltage X-ray therapy and an amount of radium sufficient to insure effective treatment. At the present time it is the opinion of the Committee that the X-ray therapy apparatus should have an effective strength of 200,000 volts, and that at least 200 milligrams of radium in the form of salt or an equivalent amount of emanation should be available.

The pathological department of the hospital must also be equipped to provide information in regard to tumors in the light of modern knowledge of this subject. Such reports should include not only the pathological diagnosis of cancer but also further details in regard to classification of the type and degree of malignancy, and, where possible, an estimate of the radio-sensitivity of the tumor.

Provision should also be made for the permanent preservation of microscopic slides and gross material, as well, and all of this material should be preserved, filed, and catalogued in such a way that a review of the material may be readily accomplished at some future time when special study of this subject may be required.

CLAUSE V

Records. In addition to the records which are required in every approved general hospital, there shall be additional records of: (a) The details of the history and of the examination for cancer in different regions of the body, such as are indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons. (b) The details of the treatment by radium or X-ray as indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons. (c) Periodic examinations at intervals for a period of at least five years following treatment.

The special records used in the cancer clinic consist chiefly of the complete record forms for history, examination, diagnosis, and treatment, which are recommended by the College with a view to making the records of different clinics uniform and comparable. Samples of these record forms may be obtained from the Department of Clinical Research of the College. To insure that all the necessary data are obtained the responsibility for filling out these forms should be placed definitely upon the examining physician. In addition, provision must be made by a card catalogue system to control the follow-up of patients after they have been discharged from the hospital, and to insure investigation of cases which fail to report to the clinic before so much time has elapsed as to make their investigation difficult.

CLAUSE VI

Treatment. The treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise.

In cases in which treatment by surgery or by radiation requires special knowledge or technique it is advisable that such treatment be given by members of the staff of the cancer clinic. However, in such cases as require treatment by surgery or by radiation which can be provided by others than members of the clinic staff, the special assignment of these cases to the staff of the cancer clinic is not essential. In general, it is to be recognized that members of the hospital staff who accept service in the cancer clinic thereby deprive themselves of certain professional experience in other lines, and it is not unreasonable to expect the other members of the staff of the hospital to recognize that fact by assenting to a reassignment of the clinical material of the hospital which will give to each member of the staff an equal opportunity for development of his special interests.

RELATION OF THE AMERICAN COLLEGE OF SURGEONS TO THE CANCER CLINIC

The American College of Surgeons through its Committee on the Treatment of Malignant Diseases, Department of Clinical Research, will co-operate with the cancer clinics in the following respects:

It will furnish to men and hospitals desiring to form such clinics information as to the methods to be adopted in the organization of the clinics.

It will put the stamp of approval of the College on such clinics as conform to the standards of the College for such clinics.

It will furnish to the clinics samples of uniform record blanks for the recording of their cases.

It will ask the clinics to co-operate in furnishing data on their cases for a scientific study of the results of treatment by various methods. This study will be a continuation of the studies that the Committee has been making during several years on data furnished by a limited number of selected clinics, the results of which have been published.

It will furnish the clinics with an opportunity of discussing their administrative problems in a series of round table conferences at each of the annual Clinical Congresses of the College and at the sectional meetings of the College which are held throughout the country each year.

It will publish and distribute to the clinics the results of its studies, based on the data collected, after analysis by the committee.

It will issue in the *Bulletin* of the College from time to time articles dealing with the administrative and scientific phases of the clinic work, and the proceedings of such round table conferences and symposiums as may be held.

It will co-operate with the clinics in such other ways as may be to their advantage.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

C. JEFF MILLER, NEW ORLEANS, *President* ALLEN B. KANAVEL, CHICAGO, *President-Elect*
FRANKLIN H. MARTIN, *Director-General*

CHARLES GORDON HEYD, *Chairman, New York Committee*
JOHN E. JENNINGS, *Chairman, Brooklyn Committee*

PRELIMINARY CLINICAL PROGRAM FOR THE NEW YORK–BROOKLYN CLINICAL CONGRESS

A PRELIMINARY program of the clinics and demonstrations to be given in the hospitals and medical schools of New York and Brooklyn during the twenty-first annual Clinical Congress of the American College of Surgeons, October 12–16, is presented in the following pages. The surgeons of greater New York are keenly interested to provide a complete showing of the surgical activities of that great medical center, and the final program will include clinics in all branches of surgery—general surgery, gynecology, obstetrics, orthopedics, urology, proctology, and surgery of the eye, ear, nose, throat, and mouth. Clinics are scheduled for Monday afternoon, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days.

The program as published at this time is merely an outline or basis for the final program. During the months preceding the Congress the hospital schedules will be revised and amplified so that in its final form the program will present a completely detailed schedule of the clinical work to be demonstrated. At three previous sessions in that city most attractive clinical programs have been presented, and we have the confident assurance of the Committee on Arrangements that in scientific interest this year's Congress will surpass all previous efforts.

Fracture clinics, at which modern methods in the treatment of fractures will be demonstrated, will be a feature of the clinical program. At many of the hospitals plans are being made for a comprehensive showing of methods employed and results obtained in the treatment of fractures, which forms so large a part of the surgical work in large cities and industrial centers. Other important features of the clinical program include demonstrations in the treatment of cancer by surgery, radium, and X-ray; electrosurgery; rehabilitation by surgery and physical therapy of patients injured in industrial accidents, etc.

Wednesday, October 14, will be "Brooklyn-Long Island Day." For that day the Committee on Arrangements is preparing a special program of clinics and demonstrations in the hospitals of that borough with other scientific features for the entertainment of the visiting surgeons.

EVENING MEETINGS

The Executive Committee of the Congress is preparing programs for a series of five evening meetings at which distinguished surgeons of the United States and Canada and eminent surgeons from abroad will present papers dealing with varied surgical subjects of present-day interest. At the presidential meeting on Monday evening in the grand ballroom, the president-elect, Dr. Allen B. Kanavel, of Chicago, will be inaugurated and deliver the annual address. Mr. Arthur H. Burgess, M.B., F.R.C.S., Manchester, England, professor of clinical surgery in Victoria University, Manchester, and president of the British Medical Association will present the John B. Murphy oration in surgery on that occasion. At one of the evening meetings Professor William Darrach, of Columbia University, will deliver the annual fracture oration. At the annual convocation of the College on Friday evening, the 1931 class of candidates for fellowship in the College will be received.

Programs are being prepared for special meetings on Tuesday and Wednesday evenings at the New York Academy of Medicine in conjunction with the sections on ophthalmology and otolaryn-

gology of the Academy, at which a number of outstanding American ophthalmologists and otolaryngologists will present papers of interest to those who practice these specialties. Complete programs for these two sessions will be published at an early date.

FEATURES OF THE PROGRAM

Among the important features of this year's Congress will be a cancer symposium, and one session devoted to a consideration of the essentials in the organization and administration of cancer clinics throughout the country under the guidance of the College.

A conference on traumatic surgery under the auspices of the Board on Industrial Medicine and Traumatic Surgery is being arranged for one day, the program for which will include presentations by leaders in industry as well as surgeons and hospital administrators.

The newest surgical films, both sound and silent, will be shown daily at headquarters. In addition to films that have been produced under the supervision of the Board on Medical Motion Picture Films of the American College of Surgeons, an extensive program of film contributions will be presented.

HOSPITAL CONFERENCE

An interesting program of papers, round table conferences, and practical demonstrations dealing with the problems related to the hospital standardization program of the College and hospital efficiency in general is being prepared for the annual hospital conference which opens at 10 o'clock on Monday morning in the grand ballroom of the Waldorf-Astoria Hotel. The conference continues Monday afternoon and on Tuesday and Wednesday both morning and afternoon. The program for this conference is planned to interest surgeons, hospital trustees, executives, and nurses, and an invitation to attend is extended to all persons interested in the hospital field.

HEADQUARTERS

General headquarters for the Clinical Congress will be established at the new Waldorf-Astoria Hotel, located on Park Avenue between 49th and 50th Streets. This magnificent new hotel, with more than 2,000 guest rooms, which is now nearing completion and will open early in the fall, affords unusual facilities for sessions of the Clinical Congress. The grand ballroom and other large rooms and foyers on the second floor of the hotel have been reserved for the exclusive use of the Congress, to be used for scientific meetings, conferences, film exhibitions, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc. All the comforts and facilities of the old Waldorf-Astoria, which had been headquarters on the occasion of three previous Congresses, will be found in the new hotel with many added attractions and conveniences.

Space has been reserved in the Astor Gallery, Jade Room, and other large rooms and foyers on the second floor of the hotel adjacent to the grand ballroom for the Technical Exhibition, in which will be represented the leading manufacturers of surgical instruments, X-ray apparatus, operating lights, hospital apparatus of all kinds, pharmaceuticals, publishers of medical books, etc.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the New York-Brooklyn session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

An application for reduced railway fares on account of the meeting in New York and Brooklyn is pending before the railroad traffic associations, and it seems assured that a round trip rate of one and one-half the regular first-class one-way fare will be in effect from all points in the United States and Canada.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY, PROCTOLOGY, SURGICAL PATHOLOGY, ETC.

CLINICS IN NEW YORK HOSPITALS

BELLEVUE HOSPITAL

Monday

WILLIAM T. DORAN and associates—2. Gall-bladder disease.
A. R. STEVENS and staff—2. Demonstration of urological cases.

Tuesday

RUSSEL H. PATTERSON—9. General surgery.
ARTHUR M. WRIGHT and staff—9. General surgery.
ARTHUR S. MCQUILLAN and EUGENE BECK—9. Diseases of the thyroid.
F. C. HOLDEN and staff—9. Gynecological clinic.
IRA KAPLAN and staff—9. Treatment of malignancies by radiation.
A. R. STEVENS and staff—2. Urological operations.

Wednesday

JOHN E. SUTTON—9. General surgery.
ARTHUR M. WRIGHT and staff—9. General surgery.
F. C. HOLDEN and staff—9. Gynecological clinic.
IRA KAPLAN and staff—9. Treatment of malignancies by radiation.
KENNETH M. LEWIS, I. E. SIRIS and LESTER BREIDENBACH—2. Fracture clinic.
A. R. STEVENS and staff—2. Urological clinic.

Thursday

Staff, second surgical division—9. General surgery, dry clinic.
JOHN H. MORRIS and JOHN V. BOHRER—9. Chest surgery.
GEORGE D. STEWART, ARTHUR M. WRIGHT and staff—11:30. General surgery, dry clinic.

Friday

CARL G. BURDICK—9. General surgery.
GEORGE D. STEWART, ARTHUR M. WRIGHT and staff—11. General surgery.
JAMES W. HINTON—2. Gastro-intestinal clinic.
A. R. STEVENS and staff—2. Urological operations.

MEDICAL CENTER

(Babies, Neurological, Presbyterian and Sloane Hospitals)

Monday

J. BENTLEY SQUIER—2. Urological operations.

Tuesday

BENJAMIN P. WATSON—9. Gynecological clinic.

Wednesday

HUGH AUCHINCLOSS—9. Surgery of the breast.

Thursday

FORDYCE B. ST. JOHN—9. Surgery of the stomach and duodenum.

Friday

WILLIAM DARRACH—9. Fracture clinic.

NEW YORK POST-GRADUATE HOSPITAL

Monday

FRED H. ALBEE—2. Orthopedic surgery.
JOHN D. STEWART—3. Rectal surgery.
B. W. MOFFATT—4:30. Orthopedic surgery.

Tuesday

J. F. MCCARTHY—9. Urology.
J. F. ERDMANN—9. General surgery.
J. EASTMAN SHEEHAN—9. Plastic surgery.
H. S. VAUGHAN—11. Oral surgery.
W. T. DANNREUTHER—2. Gynecology.
CHARLES OGILVY—4:30. Orthopedic surgery.

Wednesday

THOMAS CHERRY—9. Gynecology.
CHARLES GORDON HEYD—2. General surgery.
W. T. DANNREUTHER—2. Gynecology.
BYRON STOOKEY—2. Neurological surgery.

Thursday

FRED H. ALBEE—9. Orthopedic surgery.
J. F. MCCARTHY—9. Urology.
J. F. MOORHEAD—2. Traumatic surgery.
GEORGE ANOPOL—4:30. Orthopedic surgery.

Friday

THOMAS CHERRY—9. Gynecology.
J. EASTMAN SHEEHAN—9. Plastic surgery.
J. F. ERDMANN—2:30. General surgery.
W. T. DANNREUTHER—2. Gynecology.
CHARLES OGILVY—4:30. Orthopedic surgery.

MOUNT SINAI HOSPITAL

Monday

ROBERT T. FRANK and staff—2. Plastic operations on the vagina.
RICHARD LEWISOHN—2. Blood studies in jaundice cases.

Tuesday

EDWIN BEER and staff—2. Genito-urinary surgery.
HAROLD NEUHOF—2. Demonstration of thoracic cases.
W. HARRIS—2. Radiotherapy of surgical diseases.

Wednesday

PHILIP W. NATHAN and staff—9. Orthopedic surgery.
A. A. BERG and staff—2. Gastro-intestinal surgery.
GEORGE BAEHR and PAUL KLEMPERER—3:30. Pathological demonstration.

Thursday

RICHARD LEWISOHN and staff—2. Thyroid surgery.
ROBERT T. FRANK—2. Reconstruction of vagina; demonstration of female sex hormones, blood and urine tests.
LEOPOLD JACHES and staff—2. Roentgenological aspects of surgical diseases.

Friday

PHILIP W. NATHAN—9. Demonstration of orthopedic cases.
HAROLD NEUHOF and staff—2. Chest surgery.

WOMAN'S HOSPITAL

Tuesday

HERMAN GRAD and E. A. BULLARD—9. Gynecological operations.
H. G. BUGBEE and staff—9. Urological clinic.
GEORGE GRAY WARD, L. K. P. FARRAR and W. T. KENNEDY—2. Gynecological operations.
GRETE STOHR—2. Pathological demonstration.
W. H. GLAFKE—2:30. Gastro-enterological clinic, relating to gynecology.

Wednesday

H. E. PARDEE—9. Cases of pregnancy complicated with heart disease.
E. C. LYON and assistants—10. Demonstration of obstetrical ward and delivery room technique.
GEORGE GRAY WARD and L. K. P. FARRAR—11. Exhibit of radium cases.
GRETE STOHR—2. Pathological demonstration.

Thursday

R. M. RAWLS and A. H. ALDRIDGE—9. Gynecological operations.
H. G. BUGBEE and assistants—9. Urological clinic.
B. H. GOFF and R. HURD—2. Gynecological operations.
GRETE STOHR—2. Pathological demonstration.
HARRIET MCINTOSH—2:30. X-ray diagnosis and therapy in gynecology and obstetrics.
E. C. LYON and assistants—3. New follow-up system in obstetrics.

Friday

HERMAN GRAD and E. A. BULLARD—9. Gynecological operations.
GEORGE GRAY WARD, L. K. P. FARRAR and W. T. KENNEDY—2. Gynecological operations.
GRETE STOHR—2. Pathological demonstration.
E. C. LYON and assistants—3. Demonstration of obstetrical ward and delivery room technique.

NOTE.—Daily demonstrations "Standardized Technique," by the Nursing Staff; "Keeping of Records" by Record Librarian. Inspection of new out-patient clinic on Wednesday and Friday.

HOSPITAL FOR RUPTURED AND CRIPPLED

Tuesday

CARL G. BURDICK and staff—9. Hernia operations.
ARMITAGE WHITMAN and staff—2. Dry clinic: Adduction treatment of fractures of the neck of femur.

Wednesday

FENWICK BEEKMAN and staff—9. Hernia operations.
WILLIAM B. COLEY and BRADLEY L. COLEY—2. Dry clinic: Bone sarcomas.

Thursday

PERCY W. ROBERTS, WILLIAM L. SNEED and staff—9. Orthopedic clinic.
JOHN E. MCWHORTER—2. Pathological demonstration of bone tumors.

Friday

WILLIAM L. SNEED and staff—9. Orthopedic operations.

LYING-IN HOSPITAL

JAMES A. HARRAR, C. F. JELLINGHAUS, L. A. WING, M. ROSENSOHN, W. H. HAWKINS, K. B. STEELE, F. R. SMITH, J. A. O'REGAN, N. B. SACKETT, J. T. SHERMAN, W. C. GODDARD and R. L. CRAIG—9, daily. Obstetrical clinics and laboratory demonstrations.

ROOSEVELT HOSPITAL

Tuesday

ALFRED STILLMAN—9. General surgery.
HOWARD C. TAYLOR—9. Gynecology.
CONDICT CUTLER—10. General surgery.

Wednesday

KIRBY DWIGHT—9. General surgery.
THOMAS PEIGHTAL—9. Gynecology.
GRANT P. PENNOYER—10. General surgery.

Thursday

WILLIAM C. WHITE—9. General surgery.
HOWARD C. TAYLOR, JR.—9. Gynecology.
HOWARD A. PATTERSON—10. General surgery.

Friday

EDWARD F. KILBANE—9. Urology.

FLOWER HOSPITAL

Monday

CLAUDE BURRETT—2. Goiter problems.
EARL EATON—2. Hernia clinic.

Tuesday

HORACE AYERS—9. Tumors of the pelvis.
HENRY SAFFORD—9. Elective caesarean.
SPRAGUE CARLETON—2. Prostatic problems.
WALTER HALFMAN—2. Kidney tumors.
RAPHAEL LEWY—2. Industrial surgery.

Wednesday

LOUIS KAUFMAN—9. Hydronephritis.
SAMUEL LUBASH—9. Kidney function tests.
ANSON H. BINGHAM—2. Orthopedic surgery.
MILTON WILSON—2. Compound fractures.

Thursday

WILLIAM F. HONAN—2. Thoracic surgery.

Friday

JOSEPH H. FOBES—9. General surgery.
WILLIAM A. FRASER—9. General surgery.
WILLIAM P. ECKES—9. General surgery.
GEORGE W. LUTTON—2. Traumatic infections of the hand.
E. WELLES KELLOGG—2. Obscure infections of wounds.

Note.—Demonstrations in newer methods of anæsthesia by Donald Brace, James Gales, and George Van Gilluwe.

HARLEM HOSPITAL

Monday

Staff—2. Conference on pathology and surgery.

Tuesday

H. C. FALK and staff—9. Gynecology.
SIDNEY ADLER—2. Rectal diseases.

Wednesday

JOHN F. CONNORS, J. WISHNER, L. WRIGHT and J. STENBUCK—9. Traumatic surgery.

Thursday

H. B. EISBERG and C. CASASSA—9. General surgical clinic.
A. M. SALA and B. N. BERG—2. Surgical pathology.

Friday

H. C. FALK—9. Diagnostic gynecology.
F. KASSEBOHM—2. Obstetrical clinic.

NEW YORK POLYCLINIC HOSPITAL

Monday

FRANK C. YEOMANS—1:30. Operative proctology.
D. A. SINCLAIR—3. Urological operations.
F. C. KELLER—4:30. Dry clinic: Surgical anatomy.

Tuesday

MALCOLM CAMPBELL—9. Operative gynecology.
HAROLD D. MEEKER—11. General surgical operations.
JEROME M. LYNCH—1:30. Operative proctology.
ROSS MCPHERSON—3. Obstetrical clinic.
JOHN J. NUTT—4:30. Orthopedic operations.

Wednesday

GEORGE B. LEE—9. Gynecological operations.
A. E. SELLENINGS—11. General surgical operations.
EDWARD L. KELLOGG—1:30. Gastroenterology.
J. J. VALENTINE—3. Urological operations.
CHARLTON WALLACE and TOUFICK NICOLA—4:30. Orthopedics.

Thursday

D. W. TOVEY—9. Operative gynecology.
JOHN J. MCGRATH—11. General surgical operations.
HERBERT C. CHASE—1:30. General surgical operations.
EVERETT M. HAWKS—3. Obstetrics.
J. E. HAMMETT—4:30. Dry clinic: Surgery of tongue.

Friday

ROBERT L. MCCREADY—9. Operative gynecology.
ROBERT E. BRENNAN—11. General surgical operations.
W. V. HEALEY—1:30. Fracture clinic.
HERBERT B. REECE—3. Operative urology.

CITY HOSPITAL

Monday

E. F. KILBANE—2. Genito-urinary surgery.

Tuesday

L. W. CROSSMAN—2. General surgery.
G. E. BINKLEY—2. Rectal surgery.

Wednesday

E. M. COLIE—2. Gynecology.
J. B. CLARK—2. Genito-urinary surgery.
J. E. FULD—2. Orthopedic surgery.

Thursday

L. W. CROSSMAN—2. General surgery.

Friday

E. W. PINKHAM—2. Gynecology.
J. R. LISA—2. Pathological conference.

LEBANON HOSPITAL

Tuesday

HARRY ARANOW, A. J. RONGY and EDWARD SCHNAPER—9. Gynecology.

Wednesday

MILTON R. BOOKMAN, PHILIP M. GRAUSMAN, L. MILLER KAHN and HENRY ROTH—9. General surgery.

Thursday

HARRY ARANOW, A. J. RONGY and EDWARD SCHNAPER—9. Gynecology.

Friday

MILTON R. BOOKMAN, PHILIP M. GRAUSMAN, L. MILLER KAHN and HENRY ROTH—9. General surgery.

ST. VINCENT'S HOSPITAL

Tuesday

EDWARD L. KEYES and staff—9. Urological clinic.
GEORGE R. STUART—9. General surgery.
FRANK N. DEALY—9. General surgery.
WILLIAM G. DORAN—9. Fractures.

Wednesday

RAYMOND P. SULLIVAN—9. Surgical clinic.
WILLIAM M. FORD, W. KRUGLER, J. MCGRATH, J. HENNESSY and A. RAGGI—9. Gynecological clinic.
WILLIAM G. DORAN—2. Orthopedic clinic, congenital dislocation of hip.

Thursday

GEORGE DAVID STEWART—9. General surgical operations.
ARTHUR M. WRIGHT—9. General surgical operations.
EDWARD A. KING—9. General surgical operations.
LOUIS F. SANMAN—2. Transfusion.

Friday

WILLIAM M. FORD, W. KRUGLER, J. MCGRATH, J. HENNESSY and A. RAGGI—9. Gynecological clinic.
CONSTANTINE J. MACGUIRE—9. Surgical demonstration of cases.

HOSPITAL FOR JOINT DISEASES

Tuesday

P. M. GRAUSMAN—9. General surgery.
HARRY GOLDMAN—10. Proctological surgery.
H. L. JAFFE—11:30. Pathology.

Wednesday

H. L. FRAUENTHAL, LEO MAYER and M. M. POMERANZ—9. Orthopedic clinic, operations and demonstration of cases; roentgenological demonstration of bone lesions.

Thursday

PAUL W. ASCHNER—9. Urological surgery.
ARTHUR STEIN—10. Gynecological surgery.
M. M. POMERANZ—11. Pyelography.

Friday

H. FINKELSTEIN—9. Orthopedic operations.
SAMUEL KLEINBERG—10:30. Demonstration of orthopedic patients.

MIDTOWN HOSPITAL

Wednesday

J. SIDNEY RITTER—9:30. Urological clinic.

Thursday

LOUIS MARTON—9. General surgery.

Friday

MARTIN J. SYNNOTT—4. Proctological surgery.

KNICKERBOCKER HOSPITAL

Monday

PHILIP D. ALLEN—2. Blood transfusion, Tindermann method.

Tuesday

W. A. FRASER—9. Gynecological clinic.
H. J. SHELLEY—2. General surgery.

Wednesday

PAUL C. MORTON—9. General surgery.

BROAD STREET HOSPITAL

Monday

CHARLES GOODMAN—2. Vascular surgery.
GUSTAV TIECK—4. Sinus operations.

Tuesday

BENJAMIN TILTON—10. General surgery.
WILLIAM KELLOGG—2. Gastro-intestinal surgery.

Wednesday

A. J. WALSCHEID—10. Gynecology.
MAURICE MELTZER—2. Genito-urinary surgery.

Thursday

FRED DUNN—10. Oral surgery.
FRED H. ALBEE—2. Orthopedic surgery.

Friday

POL CORYLLOS—10. Thoracic surgery.
MAX BARUCH—2. General surgery.
T. X. SULLIVAN—4. General surgery.

METROPOLITAN HOSPITAL

Monday

J. H. FOBES and staff—2. General surgery.

Tuesday

SPRAGUE CARLETON and staff—10. Genito-urinary surgery.
W. F. HONAN and staff—2. Thoracic surgery.

Wednesday

H. B. SAFFORD and staff—10. Gynecology.
R. F. WARD and staff—2. General surgery.

Thursday

W. A. FRASER and staff—2. General surgery.

Friday

A. H. BINGHAM and staff—10. Orthopedic surgery.
L. C. SALISBURY and staff—2. General surgery.

GOUVERNEUR HOSPITAL

Monday

THOMAS H. RUSSELL—2. General surgery.

Tuesday

WILLIAM V. HEALEY—9. Fracture clinic.
EDWARD L. KELLOGG—2. General surgery.

Wednesday

WILLIAM A. KELLOGG—9. General surgery.
WILLIAM H. W. KNIPE—10. Obstetrics.
PHILIP M. GRAUSMAN—2. General surgery.

Thursday

JOSEPH GIRSDANSKY—9. General surgery.
ALBERT E. SELLENINGS—2. General surgery.

ST. MARY'S HOSPITAL

Tuesday

C. E. FARR—9. Undescended testis in children.

Thursday

EDWARD D. TRUESDELL—9. Hare-lip and cleft palate.

Friday

LUCIUS A. WING—9. Congenital deformities.

NEW YORK ORTHOPÆDIC HOSPITAL

Monday

ALAN D. SMITH and staff—2. Out-patient clinic.

Tuesday

Staff—9. Follow-up clinic.
HALFORD HALLOCK, BENJAMIN P. FARRELL and staff—2. Out-patient clinic.

Wednesday

RUSSELL A. HIBBS, BENJAMIN P. FARRELL, ALAN D. SMITH and HALFORD HALLOCK—9. Operative clinic.
ALAN D. SMITH and staff—2. Out-patient clinic.

Thursday

RUSSELL A. HIBBS and staff—9. End-results in fusion operation for tuberculosis of spine, hip, knee and ankle.
BENJAMIN P. FARRELL, HALFORD HALLOCK and staff—2. Out-patient clinic.

Friday

RUSSELL A. HIBBS, BENJAMIN P. FARRELL, ALAN D. SMITH, HALFORD HALLOCK and JOSEPH C. RISSER—9. Operative clinic.
ALAN D. SMITH—2. Out-patient clinic.

RECONSTRUCTION HOSPITAL

Monday

E. A. DOOLEY—2. Fractures of the forearm.

Tuesday

J. J. MOORHEAD—9. Traumatic surgery.
W. D. LUDLUM, JR.—2. Traumatic surgery.

Wednesday

HERBERT BERGAMINI—9. Fracture return follow-up clinic.
C. A. PETERSON—10:30. Head and spine injuries.

Thursday

W. W. LASHER—9:30. Injuries of the knee.
DAVID GOLDBLATT—10:30. Fractures of the femur.
R. S. ACKERLY—10:30. Clinic.

Friday

K. G. HANSSON—9. Physical therapy.
H. M. HERRING—9. Physical therapy.

MONTEFIORE HOSPITAL

Monday

JULIUS GOTTESMAN, MAURICE LENZ and J. M. ZIEGLER—2. Cancer clinic.

Tuesday

P. W. NATHAN—9:30. Orthopedic surgery.

Wednesday

HAROLD NEUHOF—2:30. Thoracic surgery.

Thursday

IRA COHEN—2. Neurosurgical operations.

FRENCH HOSPITAL

Tuesday

P. R. TURNURE, L. M. ALOFSIN, M. I. BLANK, H. C. FALK and staff—9. General surgery.

Wednesday

L. G. COLE and P. R. TURNURE—9. Surgical and X-ray clinic.

MEMORIAL HOSPITAL

Monday

L. CRAVER—2. Dry clinic: Lymphosarcoma, Hodgkin's disease, the leucemias.

Tuesday

W. HEALY—9. Gynecological dry clinic: Demonstration of methods used and cases being treated, end-results.
G. BINKLEY—2. Rectal operations; radium treatment; demonstration of cases and end-results.

Wednesday

W. B. COLEY—9. Bone sarcoma operations; demonstration of cases and end-results.
R. HERENDEEN—2. Dry clinic: Roentgenological demonstration of bone tumors with end-results in X-ray treatment of giant cell tumors.

Thursday

Staff—10. General conference.
B. BARRINGER—2. Urological operations plus radium treatment; demonstration of cases with end-results.

Friday

B. J. LEE—9. Operations on mammary carcinoma; demonstration of cases with end-results.
F. ADAIR—2. Operations on melomania and neurogenic sarcomas; demonstration of cases with end-results.

FORDHAM HOSPITAL

Monday

A. G. FORMAN—2. General surgical operations.

Tuesday

L. MARTON—2. General surgical operations.

Wednesday

E. R. CUNNIFFE—2. General surgical operations.

Thursday

S. W. BOORSTEIN—9. Orthopedic operations.
ALEXANDER NICOLL—2. General surgical operations.

Friday

J. H. TELFAIR—9. Obstetrical operations.
R. EMMET WALSH—2. General surgical operations.

BEEKMAN STREET HOSPITAL

Tuesday

ROBERT KENNEDY and H. HEYL—9. Fracture clinic.

Wednesday

RALPH COLP—9. Operative hernia clinic.

Thursday

W. WATTERS and W. SWIFT—9. Orthopedic operations.

JERSEY CITY HOSPITAL

(Jersey City, N. J.)

Tuesday

W. G. DORAN—2. Fracture clinic.

Wednesday

S. B. SPRAGUE—2. Fracture clinic.
C. B. KELLEY—2. Gynecological clinic.

FIFTH AVENUE HOSPITAL

Monday

BENJAMIN S. BARRINGER and staff—2. Urological operations and demonstration of cases.

Tuesday

KINGSLEY ROBERTS—9. Abdominal operations; bacteriological studies of normal and infected peritoneal cavity; prenatal clinic.
LEON S. LOIZEAUX and staff—2. Demonstration of delivery room technique.

Wednesday

DONALD GORDON—9. Fracture clinic, treatment of fractures in a general hospital.
B. B. PALMER and M. W. CARR—2. Dental prophylaxis; treatment of fractured jaws.

Thursday

F. W. BANCROFT—9. General surgical operations; gynecological dry clinic, sterility.
WILLIAM L. SNEED—2. Orthopedic operations and demonstration of cases.
LEON S. LOIZEAUX and staff—2. Demonstration of delivery room technique.

Friday

M. STANLEY-BROWN—9. General surgical operations; dry clinic, postoperative thrombosis and embolism.

NEW YORK HOSPITAL

Tuesday

JAMES MORLEY HITZROT and staff—9. General surgery.
O. S. LOWSLEY—2. Urology.

Wednesday

EUGENE H. POOL and staff—9. General surgery.
O. S. LOWSLEY—2. Clinical demonstration.

Thursday

JAMES MORLEY HITZROT and staff—9. General surgery.

Friday

EUGENE H. POOL and staff—9. General surgery.

LINCOLN HOSPITAL

Tuesday

KIRBY DWIGHT and B. SHERWIN—9. General surgical operations.
E. T. HULL—9. Gynecological operations.

Wednesday

E. D. TRUESDELL and C. S. ROGERS—9. General surgical operations.
P. H. WILLIAMS—9. Gynecological operations.
G. GOTTLIEB—2. Roentgenology.

Thursday

G. AUFRICHT and J. FRIEDMAN—9. Plastic surgery.

Friday

E. J. DAVIN—9. Gynecological operations.
KIRBY DWIGHT and staff—10. General surgery.

STUYVESANT SQUARE HOSPITAL

H. H. M. LYLE, A. S. MORROW and R. H. KENNEDY—9, daily. General surgery.

BETH ISRAEL HOSPITAL

Monday

HARRY E. ISAACS—2. General surgical operations.
HERMAN SCHWARZ—2. Surgery in children.

Tuesday

J. J. HERTZ—10. Gastric surgery.
E. G. LANGROCK—11. Surgery in obstetrics.
I. C. RUBIN—2. Gynecological operations.
MARCUS ROTHSCHILD—2. Medical aspects of surgical cases.

Wednesday

I. C. RUBIN—10. Gynecological clinic.
A. HYMAN—11. Genito-urinary clinic.
A. HYMAN—2. Genito-urinary surgery.
LEO DAVIDOFF—2. Neurosurgical operations.
E. D. FRIEDMAN—2. Neurosurgical clinic.

Thursday

M. ROBINSON—10. Gynecological clinic.
LEO DAVIDOFF—11. Neurosurgical clinic.
DEWITT STETTEN—2. General surgical operations.
A. A. EPSTEIN—2. Medical aspects of surgical cases.

Friday

DEWITT STETTEN—10. Surgical clinic.
MEYER ROBINSON—2. Gynecological operations.
ALFRED PLAUT—2. Pathological conference.

LENOX HILL HOSPITAL

Tuesday

FRANK R. OASTLER and staff—9. Gynecological clinic.
FRANK R. OASTLER and staff—2. Gynecological clinic.

Wednesday

DEWITT STETTEN and staff—9. General surgical clinic.
CARL EGGERS and staff—2. General surgical clinic.

Thursday

HERMAN FISCHER and staff—9. General surgical clinic.
OTTO H. PICKHARDT and staff—2. General surgical clinic.

Friday

PERCY H. WILLIAMS and staff—9. Gynecological clinic.
PERCY H. WILLIAMS and staff—2. Gynecological clinic.

DETENTION HOSPITAL

Tuesday

EDWARD C. BRENNER or HARRY V. SPAULDING—9. Gynecological operations.

Thursday

EDWARD C. BRENNER or JOSEPH FULD—9. Gynecological operations.

ST. LUKE'S HOSPITAL

Tuesday

WALTON MARTIN—9. General surgery.
JOHN DOUGLAS—9. General surgery.

Wednesday

H. H. M. LYLE—9. General surgery.
FRANK S. MATHEWS—9. General surgery.

Thursday

EDWARD J. DONOVAN—9. General surgery.
WILLIAM F. MACFEE and EDWARD D. TRUESDELL—9. General surgery.

Friday

MORRIS K. SMITH—9. General surgery.
HENRY G. BUGBEE—9. Genito-urinary surgery.
MATHER CLEVELAND—2. Orthopedic surgery.

MISERICORDIA HOSPITAL

Monday

F. W. SOVAK—2. Gynecology.

Tuesday

ANTHONY H. HARRIGAN—9. General surgery.

Wednesday

ROBERT E. BRENNAN—9. General surgery.
JACOB HECKMANN—2. General surgery.

Thursday

EDWARD F. KILBANE—9. Genito-urinary surgery.
ALEXANDER H. SCHMITT—2. Obstetrics.

Friday

FRANCIS E. BUTLER—9. Orthopedics.
GASTON A. CARLUCCI—2. General surgery.

CORRECTION HOSPITAL

Tuesday

EDWARD C. BRENNER—2. General surgery.

Wednesday

GEZA GREENBERG—9. Genito-urinary surgery.

Thursday

EDWARD C. BRENNER or M. O. MAGID—2. Gynecological operations.

ST. FRANCIS HOSPITAL

F. G. EDGERTON, T. H. RUSSELL, C. J. VEJVODA and E. A. CAMPBELL—9, daily. General surgery and gynecology

CLINICS IN BROOKLYN AND LONG ISLAND HOSPITALS

BROOKLYN HOSPITAL

Tuesday

W. A. SHERWOOD—9. General surgical operations.
V. L. ZIMMERMAN and staff—9. Obstetrical and gynecological clinic and conference.

Wednesday

W. A. SHERWOOD—9. General surgical operations.
V. L. ZIMMERMAN—9. Gynecological operations.
D. E. MCKENNA—12:30. Orthopedic clinic.
JOHN E. JENNINGS—2. General surgery.

Thursday

W. A. SHERWOOD—9. General surgical operations.
JOHN E. JENNINGS—9. General surgical operations.
N. P. RATHBUN—9. Cystoscopic clinic.
D. E. MCKENNA—10:30. Orthopedic operations.

Friday

W. A. SHERWOOD—9. General surgical operations.
N. P. RATHBUN—9. Urological operations.
V. L. ZIMMERMAN—9. Gynecological operations.
JAMES DENTON—11. Clinical surgical pathological conference.

CUMBERLAND HOSPITAL

Tuesday

JOHN GAINEY and staff—10. Cancer clinic, operations and demonstration of cases.

Wednesday

JOHN E. JENNINGS, M. M. FOOTE and J. J. GAINEY—9. General surgical clinic.

Thursday

MERRILL N. FOOTE and staff—9. Goiter clinic, operations and demonstration of cases.
ROBERT E. KINLOCK and staff—2. Urological clinic, operations and demonstration of cases.

Friday

JOHN E. JENNINGS—9. General surgery, dry clinic.
MERRILL N. FOOTE and F. T. SHATARA—2. Varicose vein clinic.

CONEY ISLAND HOSPITAL

Tuesday

J. EARL MILES—9:30. Gynecology.
JOHN H. CRAWFORD—2. Pre- and postoperative care of the cardiac patient.
RAY M. BOWLES—2. Preparation of the prostate case.
J. EARL MILES—2. Miles modification of the Rubin test.
ARTHUR C. GRAVES—2. Treatment of postpartum hæmorrhage.

Wednesday

GEORGE WEBB—9. General surgery.
RAY M. BOWLES—2. Urological surgery.
A. J. MENDELSOHN—2. X-ray diagnosis of peptic ulcer.
P. E. WESENBERG—2. Discussion of difficult labor.

Thursday

GEORGE WEBB and J. EARL MILES—9. General surgery.
P. I. NASH—2. Pre- and postoperative treatment of diabetic patients.
GEORGE WEBB—2. Traumatic surgery.
GEORGE G. FISHER—2. Biliary surgery, common duct stones.

WYCKOFF HEIGHTS HOSPITAL

Tuesday

JOHN L. BAUER—9. General surgery.
JOHN G. KRAUSS—9. General surgery.
RUSSELL S. FOWLER—10. General surgery.
ARTHUR HOLZMAN—10. General surgery.
WILLIAM B. ROSECRANS—10. General surgery.
RUDOLPH HERRIMAN—2. Obstetrics.
CARL O. FISCHER—3. Obstetrics.
ROSARIO MULÉ—4. Urological operations.

Wednesday

ALBERT G. COOK—9. General surgery.
WILLIAM F. BOZENHARDT—9. General surgery.
WILLIAM COOK—9. General surgery.
JOHN HORIN—11. General surgery.
CHARLES PFLUG—11. General surgery.
LEO DREXLER—2. Urological operations.
GEORGE FORBES—2. X-ray clinic.
HENRY DIRLAM—3. Obstetrics.

Thursday

JOHN L. BAUER—9. General surgery.
JOHN G. KRAUSS—9. General surgery.
RUSSELL S. FOWLER—10. General surgery.
ARTHUR HOLZMAN—10. General surgery.
WILLIAM B. ROSECRANS—10. General surgery.
RUDOLPH HERRIMAN—2. Obstetrics.
CARL O. FISCHER—3. Obstetrics.
ROSARIO MULÉ—4. Urological operations.

Friday

ALBERT G. COOK—9. General surgery.
WILLIAM F. BOZENHARDT—9. General surgery.
WILLIAM COOK—9. General surgery.
JOHN HORIN—11. General surgery.
CHARLES PFLUG—11. General surgery.
LEO DREXLER—2. Urological operations.
GEORGE FORBES—2. X-ray clinic.
HENRY DIRLAM—3. Obstetrics.

NORWEGIAN LUTHERAN DEACONESSES' HOSPITAL

Tuesday

E. FERRIS—9. General surgery.
G. HUNTER—9. Orthopedics.
C. LANGE—11. Genito-urinary surgery.
D. LIVINGSTONE—11. General surgery.
E. FERRIS, J. H. B. DOWD and C. LANGE—2. Dry clinic.

Wednesday

E. SKELTON and L. STORK—9. General surgery.
B. HARRIS and H. MEHLDAU—10. Obstetrics.
E. SKELTON, L. STORK, D. LIVINGSTONE and C. M. FISHER—2. Dry clinic.

Thursday

W. B. DUKESHIRE and P. PLATOU—9. General surgery.
ROBERT W. TATE—10. General surgery.
J. H. B. DOWD—11. Obstetrics.
W. B. DUKESHIRE, P. PLATOU and B. HARRIS—2. Dry clinic.

Friday

H. A. FISHER—9. Genito-urinary surgery.
R. P. SAN FILIPPO—9. General surgery.
WILLIAM G. FLICKINGER—10. General surgery.
WILLIAM G. FLICKINGER, R. P. SAN FILIPPO, ROBERT W. TATE and H. A. MEHLDAU—2. Dry clinic.

KINGS COUNTY HOSPITAL

Tuesday

E. H. FISKE, J. TENOPYR and J. RAPHAEL—9. General surgery.
R. M. ROME, W. E. ENNIS and H. W. BENOIT—9. General surgery.
H. E. FRASER and C. S. COCHRANE—2. Genito-urinary operations.
R. A. RENDICH—2. X-ray demonstration.

Wednesday

W. A. COAKLEY—9. Plastic surgery.
L. J. DUNN—9. Oral surgery.
E. J. BROWDER—9. Neurosurgical operations.
W. W. HALA—9. Pathology.

Thursday

E. H. FISKE, J. TENOPYR and J. RAPHAEL—9. General surgery.
R. M. ROME, W. E. ENNIS and H. W. BENOIT—9. General surgery.
C. D. NAPIER, R. C. WILLIAMS and J. B. L'EPISCOPO—2. Orthopedics.

Friday

S. J. MCNAMARA and R. H. GARLICK—9. Gynecology.
H. M. MILLS—9. Obstetrics.
C. DUNCAN and C. E. RYND—9. Gynecology and obstetrics.
H. E. FRASER and C. S. COCHRANE—2. Genito-urinary surgery.
C. F. MCCARTY—2. Physiotherapy clinic.

ST. PETER'S HOSPITAL

Tuesday

GORDON GIBSON—9. Gynecology.
J. TODD—9. Gynecology.
H. FETT—9. Orthopedics.
H. MORTON—2. Genito-urinary operations.

Wednesday

J. E. JENNINGS—9. General surgery.
T. BRENNAN—9. General surgery.
F. PAFFARD—9. General surgery.
W. ENNIS—9. Traumatic surgery.

Thursday

J. E. JENNINGS—9. General surgery.
T. M. BRENNAN—9. General surgery.
F. PAFFARD—9. General surgery.
W. ENNIS—9. Traumatic surgery.
H. MORTON—2. Genito-urinary operations.

Friday

GORDON GIBSON—9. Gynecology.
J. TODD—9. Gynecology.
H. FETT—9. Orthopedics.
H. MORTON—2. Genito-urinary operations.

ST. CATHERINE'S HOSPITAL

Tuesday

JOHN M. SCANNELL and FRANK D. JENNINGS—9. General surgery.

Wednesday

JOHN F. GRIFFIN—9. Urology.
D. GEORGE BODKIN—9. General surgery.

Thursday

CHARLES A. GORDON—9. Gynecology.

Friday

MARTIN L. BODKIN—9. Rectal surgery.
DANIEL A. MCATEER—9. General surgery.

ST. MARY'S HOSPITAL

Tuesday

WILLIAM V. PASCUAL—9. General surgery.
P. J. DULLIGAN—9. General surgery.
E. A. KEYES—9. Gynecology.
R. B. ANDERSON—9. Urology.
Staff—2. Fracture clinic.

Wednesday

J. P. MURPHY—9. General surgery.
T. M. BRENNAN—9. General surgery.
J. P. GLYNN—9. Gynecology.
J. A. SHIELDS—9. Proctology.

Thursday

WILLIAM V. PASCUAL—9. General surgery.
P. J. DULLIGAN—9. General surgery.
E. A. KEYES—9. Gynecology.
R. B. ANDERSON—9. Urology.
Staff—2. General surgery dry clinic, transfusion.

Friday

J. P. MURPHY—9. General surgery.
T. M. BRENNAN—9. General surgery.
J. P. GLYNN—9. Gynecology.
T. A. SHIELDS—9. Proctology.

METHODIST EPISCOPAL HOSPITAL

Tuesday

R. S. FOWLER, T. B. SPENCE, C. H. GOODRICH and H. K. BELL—9. General surgery.
O. P. HUMPSTONE and H. B. MATTHEWS—9. Obstetrics.

Wednesday

H. F. GRAHAM, A. H. BOGART and P. A. RENAUD—9. General surgery.
R. M. BEACH and H. W. MAYES—9. Obstetrics.

Thursday

H. T. LANGWORTHY—9. Urological clinic.
R. S. FOWLER, T. B. SPENCE, C. H. GOODRICH, R. F. SEIDENSTICKER and H. K. BELL—9. General surgery.
O. P. HUMPSTONE and H. B. MATTHEWS—9. Obstetrics.

Friday

H. F. GRAHAM, A. H. BOGART and P. A. RENAUD—9. General surgery.
R. M. BEACH and H. W. MAYES—9. Obstetrics.

CALEDONIAN HOSPITAL

Tuesday

CALVIN BARBER—9. General surgical operations.
JOSEPH TENOPYR—9. General surgery, dry clinic.

Wednesday

WILLIAM A. JEWETT—9. Gynecology.
JOSEPH TENOPYR—9. Gynecology.
CHARLES S. COCHRANE—2. Genito-urinary clinic.

Thursday

CALVIN BARBER—9. General surgery.
JOSEPH TENOPYR—9. General surgery, dry clinic.

Friday

WILLIAM A. JEWETT—9. Obstetrics.
JOSEPH TENOPYR—9. Fracture clinic.
CHARLES S. COCHRANE—2. Genito-urinary operations.

LONG ISLAND COLLEGE HOSPITAL

Tuesday

J. O. Polak, William A. Jewett, Gordon Gibson, H. B. Matthews and A. C. Beck—9. Obstetrics and gynecology.
J. D. Rushmore—9. Orthopedics.

Wednesday

Emil Goetsch, R. E. Barber, S. P. Bartley, Arthur Goetsch and R. F. Harloe—9. General surgery.
J. D. Rushmore—9. Orthopedics.
Emil Goetsch—2. General surgery.

Thursday

J. O. Polak, W. A. Jewett, Gordon Gibson, H. B. Matthews and A. C. Beck—9. Obstetrics and gynecology.
J. D. Rushmore—9. Orthopedics.
J. S. Read, F. L. Senger and A. L. Harris—2. Urology.

Friday

Emil Goetsch, R. F. Barber, S. P. Bartley, Arthur Goetsch and R. F. Harloe—9. General surgery.
J. D. Rushmore—9. Orthopedics.
J. S. Read, F. L. Senger and A. L. Harris—2. Urology.

BUSHWICK HOSPITAL

Tuesday

Harry W. Dangler—9. Gynecological clinic.
Richard C. Weithas—2. Genito-urinary clinic.

Wednesday

George H. Reichers—9. General surgery.
Adolph V. P. Fardelman—9. General surgery.
Philip E. Smith—2. General surgery.

Thursday

Nathan H. Adler—9. Emergency obstetrics and ward rounds.
W. E. Lippold and S. S. Schussheim—9. Gynecological clinic.
Gerard Kasper—2. General surgery.

Friday

H. Wright Benoit—9. General surgery.

JEWISH HOSPITAL

Tuesday

John Linder—9. General surgery.
Leo S. Schwartz—2. Gynecological operations.

Wednesday

William Linder—9. General surgery.
Adolph Bonner—2. Gynecological operations.

Thursday

John Linder—9. General surgery.
Leo S. Schwartz—2. Gynecological operations.

Friday

William Linder—9. General surgery.
Adolph Bonner—2. Gynecological operations.

HOLY FAMILY HOSPITAL

Tuesday

James M. Downey—9. General surgical operations.

Wednesday

Edwin L. Fiske—9. General surgical operations.

Thursday

Joseph S. Baldwin—9. General surgical operations.

ST. JOHN'S HOSPITAL

Tuesday

Warren L. Duffield—9. General surgery.
Stanley B. Thomas—9. General surgery.
Robert B. Anderson—10. Genito-urinary operations.
Onslow A. Gordon, Jr.—2. Obstetrics.

Wednesday

Harold K. Bell—9. General surgery.
G. Frank Sammis—9. Plastic surgery.
Augustus Harris—9. Genito-urinary operations.
Alfred W. White—2. Obstetrics.

Thursday

Robert B. Anderson—9. Genito-urinary operations.
Stanley B. Thomas—9. General surgery.
Cameron Duncan—2. Obstetrics.

Friday

G. Frank Sammis—9. General surgery.
Warren L. Duffield—9. General surgery.
Harold K. Bell—9. General surgery.

GREENPOINT HOSPITAL

Tuesday

A. L. Soresi—9. General surgery.
Charles A. Gordon—2. Gynecological clinic.

Wednesday

P. J. Dulligan—9. General surgery.
Thurston Welton—2. Gynecological clinic.

Thursday

John Smith, Jr.—9. General surgery.
Emil F. Koch—2. Pathological demonstration.

Friday

Joseph S. Baldwin—9. General surgery.

CARSON C. PECK MEMORIAL HOSPITAL

Tuesday

J. F. Ranken—9. General surgical operations.
O. A. Gordon, Jr.—2. Obstetrics.

Wednesday

C. S. Cochrane—9. General surgical operations.
H. C. Allen—2. Obstetrics.

Thursday

T. L. Vosseler—9. General surgical operations.

Friday

H. T. Wikle—9. General surgical operations.

NORTH COUNTRY COMMUNITY HOSPITAL

(Glen Cove)

Tuesday

A. M. Bell—9. Operative obstetrics.
E. C. Jessup—9. Medical demonstrations.

Wednesday

R. Derby—9. General surgical operations.
J. W. Bulmer—9. Surgical demonstrations.

Thursday

M. C. Hill—9. Pediatrics.
G. F. Hoch—9. Urological operations.

Friday

L. D. Larimore—9. Laboratory demonstration.

LUTHERAN HOSPITAL

Tuesday

A. V. P. FARDELMANN—9. General surgery.
N. P. RATHBUN—9. Urological clinic.

Wednesday

H. C. EICHACKER—9. Obstetrics.
HEINRICH WEHRBEIN—9. Urological clinic.

Thursday

VINCENT BARBER—9. General surgery.
CAMERON DUNCAN—9. Gynecology.

Friday

EDWARD MAY—9. Obstetrics.

KINGSTON AVENUE HOSPITAL

Wednesday

JOHN A. TIMM—9. Surgical complications of contagious diseases.

Thursday

RALPH F. HARLOE—2. Empyemas complicating contagious diseases.

JAMAICA HOSPITAL

(Richmond Hill)

Tuesday

H. W. BARBER—9. General surgical operations.
H. C. COURTEN—2. Orthopedic operations.

Wednesday

W. H. JESSUP—9. General surgical operations.
E. J. BUXBAUM—2. Pathological conference.

Thursday

L. H. MOSS—9. General surgical operations.
A. L. VOLTZ—2. X-ray conference.

Friday

H. W. NEAIL—9. Gynecological operations.
A. E. BAKER—9. Obstetrical operations.
H. C. COURTEN and A. L. VOLTZ—2. Fracture and X-ray conference.

ST. JOHN'S HOSPITAL

(Long Island City)

Tuesday

D. E. MCMAHON, I. L. STEIN and staff—9. General surgical operations.
J. J. MCMAHON and staff—2. Gynecological operations.

Wednesday

J. P. MCHUGH, M. WEINSTEIN and staff—9. General surgical operations.
H. P. MENCKEN and staff—2. Obstetrics.

Thursday

W. J. LAVELLE, S. M. COHEN and staff—9. General surgical operations.
G. C. BIONDI and staff—2. Urological operations.

Friday

D. E. MCMAHON, I. L. STEIN and staff—9. General surgical operations.

MARY IMMACULATE HOSPITAL

(Jamaica)

Tuesday

FRANK M. DEALY—9. General surgery.

Wednesday

JOHN M. SCANNELL—9. General surgery and demonstration of blood transfusion.
HENRY C. COURTEN—2. Orthopedic surgery.

Thursday

LOUIS LICHT—9. General surgery.
ROBERT B. ANDERSON—9. Genito-urinary surgery.
EMIL F. KOCH—2. Surgical pathology.

Friday

JOHN M. SCANNELL—9. General surgery and spinal anæsthesia demonstrations.
ALLEN ROBINSON—2. Radium therapy.

FLUSHING HOSPITAL

(Flushing)

Tuesday

G. J. J. LAWRENCE—9:30. Gynecological operations.
J. W. WICKHAM—9:30. General surgical operations.
J. L. MORRISSEY—11. Gynecological operations.
J. S. THOMAS—11. General surgical operations.

Wednesday

G. J. J. LAWRENCE—9:30. Gynecological operations.
J. G. THOMAS—9:30. Surgical demonstrations.
J. S. THOMAS—11. General surgical operations.
J. L. MORRISSEY—11. Gynecological operations.

Thursday

J. S. THOMAS, W. K. ROGERS and J. DER. COMBES—9:30. Fracture demonstration.
G. J. J. LAWRENCE and J. L. MORRISSEY—9:30. Gynecological operations.

NASSAU HOSPITAL

(Mineola)

Tuesday

W. M. POST and A. S. WARINNER—9. General surgery.
W. L. SNEED—9. Orthopedic operations.

Wednesday

B. W. SEAMAN and C. A. HETTESHEIMER—9. General surgery.
O. C. HUDSON—9. Orthopedic operations.

Thursday

H. C. MARTIN—9. Obstetrics and gynecology.
G. F. CLEGHORN—9. General surgery.
J. W. MCCHESNEY—9. Urology.

Friday

G. F. CLEGHORN and W. S. S. HORTON—9. General surgery.

HOUSE OF ST. GILES THE CRIPPLE

Tuesday

JOSEPH B. L'EPISCOPO and CHARLES DWIGHT NAPIER—10. Orthopedic clinic.

Thursday

JOSEPH B. L'EPISCOPO and CHARLES DWIGHT NAPIER—10. Orthopedic clinic.

SURGERY OF THE EYE, EAR, NOSE AND THROAT

CLINICS IN NEW YORK HOSPITALS

NEW YORK EYE AND EAR INFIRMARY

Monday

T. Laurence Saunders—2. Ear, nose and throat operations.
Clyde S. McDannald and Truman L. Boyes—2. Eye operations.

Tuesday

W. W. Weeks, Wendell L. Hughes, Mary Landis and R. E. Meek—9. Demonstration of muscular anomalies; visual field changes; retinal detachment.
G. S. Dixon and I. Schwartz—10. Demonstration of X-ray pictures of mastoid process and nasal accessory sinuses.
B. W. Key, W. B. Doherty, A. Grimaldi, B. S. Beach and H. Van Lammers—2. Eye surgery.
J. Morrisset Smith—2. Ear, nose and throat operations.

Wednesday

Bernard Samuels, A. B. Reese and E. Burchell—9. Sympathetic ophthalmics in relation to site of wound; traumatism to retina and choroid; pigmentation of retina in detachment; anatomy of temporal bone.
E. B. Burchell—10. Accessory sinuses, relation to orbit (lantern slide demonstration); bacteriology of ear.
Francis W. Shine, S. P. Oast, S. A. Agatson and Jessie B. Stark—2. Eye surgery.
Stuart L. Craig—2. Ear, nose and throat operations.

Thursday

Conrad Berens and associates—9. Ophthalmological clinic.
E. B. Burchell. Anatomy of the accessory sinus, variations and relation to orbit and its contents. Discussion by Conrad Berens.
Willis Knighton. Recent advances in cataract surgery with results.
E. J. Bassen. Glaucoma operations and results.
J. Morrisset Smith—9. Mastoid operations, anatomy of facial nerve (demonstration on cadaver).
E. B. Burchell—9. Anatomy of temporal bone (lantern slide demonstration).
John McCoy—2. Ear, nose and throat operations.
W. W. Weeks, T. H. Johnson, W. L. Hughes, and R. E. Meek—2. Eye operations.

Friday

Clyde E. McDannald and Truman L. Boyes—9. Eye clinic.
G. S. Dixon and I. Schwartz—10. Demonstration of X-ray pictures of mastoid process and nasal accessory sinuses.
Bernard Samuels, Conrad Berens, Isadore Goldstein and Willis Knighton—2. Eye operations.
Hugh B. Blackwell—2. Ear, nose and throat operations.

KNAPP MEMORIAL EYE HOSPITAL

Tuesday

Arnold Knapp and staff—2. Eye operations.

Wednesday

Arnold Knapp and staff—2. Eye operations.

Thursday

Arnold Knapp and staff—2. Eye operations.

MANHATTAN EYE, EAR AND THROAT HOSPITAL

Monday

H. W. Wootton and L. W. Crigler—2. Eye operations.

Tuesday

David Jones—12:30. Tonsil clinic.
John R. Page and staff—2. Ear clinic.
Ross Faulkner and staff—2. Nose and throat clinic.
F. M. Low—2. Demonstration of X-ray.
A. J. Eggston—2. Demonstration of pathology.
H. R. Skeel and G. W. Frey, Jr.—2. Eye operations.

Wednesday

G. Allen Robinson—9. Demonstration of use of radium in ear, nose and throat malignant tumors.
David Jones—12:30. Tonsil clinic.
A. B. Duell and staff—2. Ear clinic.
Harmon Smith and staff—2. Nose and throat clinic.
E. M. Low—2. X-ray demonstration.
A. J. Eggston—2. Pathological demonstration.
S. C. Keil and A. D. Mittendorf—2. Eye operations.

Thursday

C. J. Imperatori—10. Bronchoscopic clinic.
David Jones—12:30. Tonsil clinic.
E. P. Fowler and staff—2. Ear clinic.
Francis White and staff—2. Nose and throat clinic.
E. P. Fowler—2. Clinical research of ear.
N. Del. L. Fletcher and J. S. Van Fleet—2. Eye operations.

Friday

G. Allen Robinson—9. Demonstration of use of radium in ear, nose and throat benign tumors.
David Jones—12:30. Tonsil clinic.
John Rae—2. Ear clinic.
J. E. MacKenty—2. Nose and throat clinic.
D. H. Webster and M. Cohen—2. Eye operations.

BETH ISRAEL HOSPITAL

Monday

Alfred A. Schwartz—2. Clinic in neuro-otology.

Tuesday

Joseph W. Miller—9. Bronchoscopic diagnostic clinic.
Ervin Torok, S. Slouka and Frederick Newman—2. Eye clinic.

Wednesday

Mark Gottlieb—2. Ear surgery.
Lawrence D. Redway—2. Demonstration of colored photography of living eye.

Thursday

William Spielberg—9. Rhinological surgery.
S. J. Kopetzky—2. Otological operations.
Ervin Torok, S. Slouka and Frederick Newman—2. Eye operations.

Friday

Harold J. Isaacs—2. Nose and throat clinic.

HOSPITAL FOR JOINT DISEASES

Tuesday

Alfred Braun—10:45. Ear, nose and throat operations.

NEW YORK POST-GRADUATE HOSPITAL

Monday

ROBERT BUCKLEY—2. Laryngectomy or pharyngotomy for malignancy.
CLARENCE H. SMITH and staff—2. Otological operations.
E. M. ALGER—3:30. Eye operations and demonstration of cases.
LOUISE H. MEEKER—4. Pathology of nose and throat.

Tuesday

L. H. MEEKER—9. Pathological lantern slide demonstration of eye cases.
C. J. IMPERATORI—9. Bronchoscopy.
MARVIN F. JONES—10. Histological examination of the temporal bone in serial sections.
ARTHUR NILSON—11. Ethmoid sinus operations.
G. ALLEN ROBINSON—2. Demonstration of radium as a therapeutic agent.
MARVIN F. JONES and staff—2. Otological operations.
C. M. GRIFFITH—3. Caldwell-Luc and Denker operations.
MARTIN COHEN—3:30. Eye operations and demonstration of cases.

Wednesday

JAMES W. WHITE and R. AEBLI—9. Eye muscle operations; muscular anomalies.
VICTOR ANDERSON—9. Neck dissection and demonstration of surgical anatomy.
RAYMOND J. GAFFNEY—9. Otological operations.
ROBERT BUCKLEY—2. Laryngectomy and pharyngotomy with removal of hyoid as approach for malignancy.
GUSTAV AUFRECHT—2. Rib transplant for nasal deformity.
CLARENCE H. SMITH and staff—2. Otological operations.
DAVID ALPERIN—3:30. Eye operations and demonstration of cases.

Thursday

L. H. MEEKER—9. Pathological conditions of the eye (lantern slide demonstration).
C. J. IMPERATORI—9. Opaque foreign bodies (lantern slide demonstration).
DUNCAN MACPHERSON—10. Frontal sinus operations.
MARVIN F. JONES—10. Histological examination of the temporal bone in serial sections.
ARTHUR NILSEN—2. Caldwell-Luc operation.
C. J. IMPERATORI—2. Endoscopy and laryngeal operations.
MARVIN F. JONES and staff—2. Otological operations.
MARTIN COHEN—3:30. Eye operations and demonstration of cases.

Friday

J. W. WHITE and R. AEBLI—9. Eye muscle operations; muscular anomalies.
T. J. HARRIS—9. Tuberculosis of larynx (lantern slides).
R. H. HUTCHINSON, JR.—10. Cochlear, audiometric and vestibular tests.
E. M. ALGER—3:30. Eye operations and demonstration of cases.

FORDHAM HOSPITAL

Tuesday

JOSEPH D. KELLY—9. Otolaryngological operations.

Wednesday

S. H. BASCH—9. Otolaryngological operations.

Friday

H. G. WINCOR—9. Ophthalmological operations.

BELLEVUE HOSPITAL

Monday

WILLIAM B. DOHERTY and E. B. GRESSER—2. Eye operations.
R. T. ATKINS—2. Ear, nose and throat operations.

Tuesday

JOHN MILLER and E. H. MOYLE—10. Bronchoscopic clinic.
W. C. BOWERS—2. Ear, nose and throat operations.
S. A. AGATSON and E. A. TUSAK—2. Eye operations.

Wednesday

WEBB W. WEEKS, E. B. GRESSER and A. E. TOWN—9. Pathological eye specimens, gross and microscopic.
J. W. FOWLKES—10. Postoperative mastoid clinic.
JOHN MILLER—2. Laryngological clinic.
WEBB W. WEEKS, WILLIAM B. DOHERTY, S. P. OAST and S. A. AGATSON—2. Eye operations.
C. J. IMPERATORI—3. Bronchoscopic clinic.

Thursday

WEBB W. WEEKS and S. A. AGATSON—9. Ophthalmoscopic cases.
E. H. MOYLE—10. Anatomical demonstration, ear, nose and throat specimens.
J. W. FOWLKES and V. C. MCCUAIG—2. Ear, nose and throat operations.
S. P. OAST and E. A. TUSAK—2. Eye operations.

Friday

WEBB W. WEEKS, E. B. GRESSER and A. E. TOWN—9. Pathological eye specimens, gross and microscopic.
JOHN GUTTMAN—9. Neuro-otology.
EDGAR M. POPE and J. SWIFT HANLEY—2. Ear, nose and throat operations.
E. B. GRESSER and WEBB W. WEEKS—2. Eye operations.

NEW YORK POLYCLINIC HOSPITAL

Monday

WILLIAM L. GATEWOOD—2. Nose and throat operations.
ERVIN TOROK—3. Ophthalmology.
JOHN MCCOY and staff—4. Otology.

Tuesday

LEE M. HURD—2. Nose and throat operations.
C. E. MCDANNALD and T. A. NORTHCOTT—3. Ophthalmology.
SAMUEL J. KOPETZKY—4. Otology.

Wednesday

ERVIN TOROK and JOHN RICHARDSON—9. Ophthalmological operations.
WILLIAM L. GATEWOOD—2. Nose and throat clinic.
JOHN MCCOY and staff—4. Otological operations.

Thursday

LEE M. HURD—2. Nose and throat clinic.
C. E. MCDANNALD and T. A. NORTHCOTT—3. Ophthalmological operations.
S. J. KOPETZKY—4. Otological operations.

Friday

LAWRENCE D. REDWAY—9. Colored photography of living eye.
HENRY B. ORTON—2. Bronchoscopy.
ERVIN TOROK—3. Ophthalmology.
JOHN MCCOY and staff—4. Otology.

PRESBYTERIAN HOSPITAL

Monday

HARRY NEIVERT—2. Ear, nose and throat clinic.

Tuesday

THOMAS H. JOHNSON—10. Eye manifestations of brain conditions.
C. G. COAKLEY—10. Follow-up clinic, ear, nose and throat cases.
JOHN H. DUNNINGTON—2. Eye operations.
LEE R. PIERCE—2. Ear, nose and throat clinic.
JOHN KERNAN—2. Bronchoscopy.

Wednesday

DANIEL B. KIRBY—10. Eye tissue culture demonstrations.
HARRY NEIVERT—10. Anatomical demonstration.
GEORGE R. BRIGHTON—2. Ear, nose and throat clinic.

Thursday

JOHN M. WHEELER—10. Results of eye operations.
JAMES W. BABCOCK—10. Follow-up clinic, ear, nose and throat cases.
JOHN M. WHEELER—2. Eye operations.
CHARLES N. HARPER—2. Ear, nose and throat clinic.

Friday

JOHN H. DUNNINGTON—10. Demonstration of eye muscle conditions.
PAGE NORTHINGTON—10. Studies in deafness.
JOHN H. DUNNINGTON—2. Eye operations.
GEORGE V. BROWNE—2. Ear, nose and throat clinic.

ST. LUKE'S HOSPITAL

Monday

WESTLEY M. HUNT—2. Nose and throat clinic.
ALFRED WIENER, ISAAC HARTSHORNE, CHARLES LITTWIN, HENRY SMITH and RAYMOND E. MEEK—2. Eye clinic.

Tuesday

CARL M. SAUTTER—2. Ear clinic.
L. T. PERRAULT and W. M. HUNT—2. Bronchoscopic clinic.
ALFRED WIENER, ISAAC HARTSHORNE, CHARLES LITTWIN, HENRY SMITH and RAYMOND E. MEEK—2:30. Eye operations.

Wednesday

A. P. VOISLAWSKY and staff—2. Nose and throat operations.
ALFRED WIENER, ISAAC HARTSHORNE, CHARLES LITTWIN, HENRY SMITH and RAYMOND E. MEEK—2. Eye clinic.

Thursday

WESLEY C. BOWERS and staff—2. Radical mastoid with primary skin graft.

Friday

ALFRED WIENER, ISAAC HARTSHORNE, CHARLES LITTWIN, HENRY SMITH and RAYMOND E. MEEK—2. Eye clinic.

LEBANON HOSPITAL

Monday

M. D. LEDERMAN and ISAAC M. HELLER—2. Otolaryngology.

Friday

M. D. LEDERMAN and ISAAC M. HELLER—2. Otolaryngology.

MT. SINAI HOSPITAL

Monday

SIDNEY YANKAUER, MERWIN MYERSON and RUDOLPH KRAMER—2. Bronchoscopy.
J. WOLFF, K. SCHLIVEK and I. GOLDSTEIN—2. Eye clinic.

Tuesday

I. FRIESNER, J. MAYBAUM, WALTER HORN, S. ROSEN, JOSEPH G. DRUSS and HARRY ROSENWASSER—9. Ear operations and demonstration of cases.
I. GOLDSTEIN—10. Ocular pathology.
SIDNEY YANKAUER, MERWIN MYERSON and RUDOLPH KRAMER—2. Nose and throat clinic.

Wednesday

I. FRIESNER, J. MAYBAUM, WALTER HORN, S. ROSEN, JOSEPH G. DRUSS and HARRY ROSENWASSER—9. Ear operations and demonstration of cases.
R. LAMBERT—10. Fundus photography.

Thursday

SIDNEY YANKAUER, MERWIN MYERSON and RUDOLPH KRAMER—2. Bronchoscopy.
I. GOLDSTEIN—10. Ocular pathology.
J. WOLFF, K. SCHLIVEK and I. GOLDSTEIN—2. Eye clinic.

Friday

SIDNEY YANKAUER, MERWIN MYERSON and RUDOLPH KRAMER—2. Nose and throat clinic.
H. MINSKY—10. Improved methods of focal illumination and transillumination.

CITY HOSPITAL

Monday

A. N. SCHILLER—2. Ear, nose and throat clinic.

Thursday

O. C. RISCH—2. Ear, nose and throat clinic.

ST. MARY'S HOSPITAL

Wednesday

JAMES W. BABCOCK—9. Ear, nose and throat conditions in children.

FLOWER HOSPITAL

Thursday

J. A. W. HETRICK—2. Mastoid problems.
EDWIN S. MUNSON—2. Muscular imbalance of the eye.
WILLIAM MCLEAN—2. Cataracts (Barraquer technique).
ARTHUR CHAMBERS—2. Ophthalmological clinic.

LINCOLN HOSPITAL

Tuesday

J. S. HANLEY—2. Otolaryngological operations.

Thursday

H. K. LIGGETT and M. BERGER—2. Otolaryngological operations.

MORRISANIA HOSPITAL

Tuesday

CLARENCE H. SMITH and staff—2. Otolaryngological operations.

Thursday

DAVID H. JONES—2. Bronchoscopic clinic.

FIFTH AVENUE HOSPITAL

Thursday

WESTLEY M. HUNT—2. Otolaryngological operations and demonstration of cases.

Friday

LEGRAND H. HARDY and Z. H. ELLIS—2. Ophthalmological operations and demonstration of cases.

MIDTOWN HOSPITAL

Monday

RAYMOND LOSEY—2. Ophthalmological surgery.

Tuesday

BENJAMIN FREUDENFALL—9:30. Nose and throat surgery.

ST. VINCENT'S HOSPITAL

Monday

JOHN D. KERNAN—2. Bronchoscopic clinic.

Tuesday

JOHN M. LORE—2. Bronchoscopic clinic.

GOUVERNEUR HOSPITAL

Friday

WILLIAM L. GATEWOOD—2. Nose and throat clinic.

LENOX HILL HOSPITAL

Thursday

JOHN KERNAN and G. F. OBERRENDER—9. Bronchoscopic clinic.

RUDOLF C. DENIG, JOHN J. REID and F. VINCENT GUINEE—2. Eye operations.

CORRECTION HOSPITAL

Monday

JAMES W. SMITH—2. Ophthalmic surgery.

Friday

JOSEPH ROSENBERG—9. Ear, nose and throat clinic.

METROPOLITAN HOSPITAL

Thursday

J. A. W. HETRICK and staff—10. Surgery of the nose and throat.

HARLEM HOSPITAL

Wednesday

L. HUBBY—2. Otolaryngology.

MISERICORDIA HOSPITAL

Tuesday

ROBERT E. BUCKLEY—2. Ear, nose and throat operations.

CLINICS IN BROOKLYN AND LONG ISLAND HOSPITALS

BROOKLYN EYE AND EAR HOSPITAL

Tuesday

C. G. CRANE, F. H. LASHER, and F. J. MCCAMMON—2. Ear, nose and throat clinic.

J. OHLY, D. BISHOP, and E. C. PLACE—2. Eye clinic.

Wednesday

Staff—9. Special clinical demonstrations in ophthalmology and otolaryngology.

H. H. WAUGH, JAMES ANDREW and E. M. BEERY—2. Eye clinic.

F. L. TUCKER, W. HERBERT and I. G. CAMERON—2. Ear, nose and throat clinic.

Thursday

C. G. CRANE, F. H. LASHER and F. J. MCCAMMON—2. Ear, nose and throat clinic.

J. OHLY, D. BISHOP and E. C. PLACE—2. Eye clinic.

Friday

H. H. WAUGH, JAMES ANDREW and E. M. BEERY—2. Eye clinic.

F. L. TUCKER, W. HERBERT and I. G. CAMERON—2. Ear, nose and throat clinic.

BROOKLYN HOSPITAL

Wednesday

C. G. CRANE—2. Ear, nose and throat operations and bronchoscopic clinic.

Friday

C. G. CRANE—2. Ear, nose and throat operations and bronchoscopic clinic.

WYCKOFF HEIGHTS HOSPITAL

Tuesday

ROBERT L. MOORHEAD—2. Nose and throat clinic.

CARL MUELLER, SR.—3. Ophthalmological operations.

Wednesday

CARL H. MUELLER, JR.—2. Nose and throat clinic.

IRVING CAMERON—3. Nose and throat clinic.

Thursday

ROBERT L. MOORHEAD—2. Nose and throat clinic.

CARL MUELLER, SR.—3. Ophthalmological operations.

Friday

CARL H. MUELLER, JR.—2. Nose and throat clinic.

IRVING CAMERON—3. Nose and throat clinic.

ST. CATHERINE'S HOSPITAL

Tuesday

S. H. DECOSTE—2. Ear, nose and throat clinic.

Wednesday

JOSEPH E. GOLDING—2. Ophthalmology.

Thursday

G. GARTHWAITE FISHER—2. Ear, nose and throat clinic.

CALEDONIAN HOSPITAL

Tuesday

JOHN W. DURKEE—2. Otology.

Thursday

JOHN W. DURKEE—2. Otological operations.

LUTHERAN HOSPITAL

Tuesday

A. GILLIGAN—9. Otolaryngology.

Wednesday

PETER KEIL—9. Otolaryngology.

Thursday

A. GILLIGAN—9. Otolaryngology.
LEON W. GREEN—2. Ophthalmological clinic.

Friday

PETER KEIL—9. Otolaryngology.

CUMBERLAND HOSPITAL

Tuesday

JOHN H. BAILEY and staff—2. Eye clinic, operations and demonstration of cases.

Wednesday

F. H. LASHER and staff—2. Nose and throat clinic, operations, bronchoscopy, demonstration of cases.

KINGS COUNTY HOSPITAL

Tuesday

J. W. DURKEE and M. G. GOLDEN—9. Otolaryngology.

Wednesday

J. OHLY and W. MOEHLE—2. Eye surgery.
J. W. DURKEE and M. C. MYERSON—2. Otolaryngology.
C. A. HARGITT—2. Eye clinic.

METHODIST EPISCOPAL HOSPITAL

Wednesday

C. L. STONE, C. A. ANDERSON, E. A. SUNDE and H. GLEDHILL—2. Otolaryngology.

Friday

C. L. STONE, C. A. ANDERSON, E. A. SUNDE and H. GLEDHILL—2. Otolaryngology.

ST. MARY'S HOSPITAL

Tuesday

G. E. DEELY—2. Nose and throat clinic.

Thursday

G. E. DEELY—2. Nose and throat clinic.

JAMAICA HOSPITAL
(Richmond Hill)

Wednesday

J. KANE—2. Eye, ear, nose and throat clinic.

Thursday

A. J. SHEKTER—2. Eye, ear, nose and throat clinic.

MARY IMMACULATE HOSPITAL
(Jamaica)

Tuesday

DANIEL S. CUNNING—9. Nose and throat clinic.

Wednesday

EDWARD FROTHINGHAM—9. Nose and throat clinic.

ST. JOHN'S HOSPITAL

Tuesday

JOHN P. BAKER—2. Otolaryngology.

Wednesday

ROBERT L. MOORHEAD—2. Otolaryngology.

Thursday

JOHN P. BAKER—2. Otolaryngology.

Friday

ROBERT L. MOORHEAD—2. Otolaryngology.

JEWISH HOSPITAL

Tuesday

EDWARD L. BERGER—2. Nose and throat operations.

Wednesday

PHILIP LEIBOWITZ—2. Nose and throat clinic

Thursday

EDWARD L. BERGER—2. Nose and throat operations.

Friday

PHILIP LEIBOWITZ—2. Nose and throat operations.

ST. PETER'S HOSPITAL

Tuesday

A. KEENAN—2. Nose and throat clinic.

Wednesday

M. G. GOLDEN—2. Bronchoscopy.

Thursday

M. G. GOLDEN—2. Nose and throat clinic.

LONG ISLAND COLLEGE HOSPITAL

Tuesday

C. W. STICKLE—2. Laryngology.
H. M. SMITH—2. Ophthalmology.

GREENPOINT HOSPITAL

Wednesday

JOSEPH E. BRAUNSTEIN and staff—2. Nose and throat clinic.

NASSAU HOSPITAL
(Mineola)

Friday

H. B. SMITH—9. Nose and throat clinic.

NORTH COUNTRY COMMUNITY HOSPITAL
(Glen Cove)

Friday

G. H. COX—9. Nose and throat operations.

ST. JOHN'S HOSPITAL
(Long Island City)

Friday

P. J. KENNEDY and staff—2. Bronchoscopy.